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SCIENTIFIC AMERICAN

JANUARY 1928 *Thirty-five Cents a Copy*

ANCIENT MAYAN ASTRONOMY

By HERBERT J. SPINDEN, Ph.D

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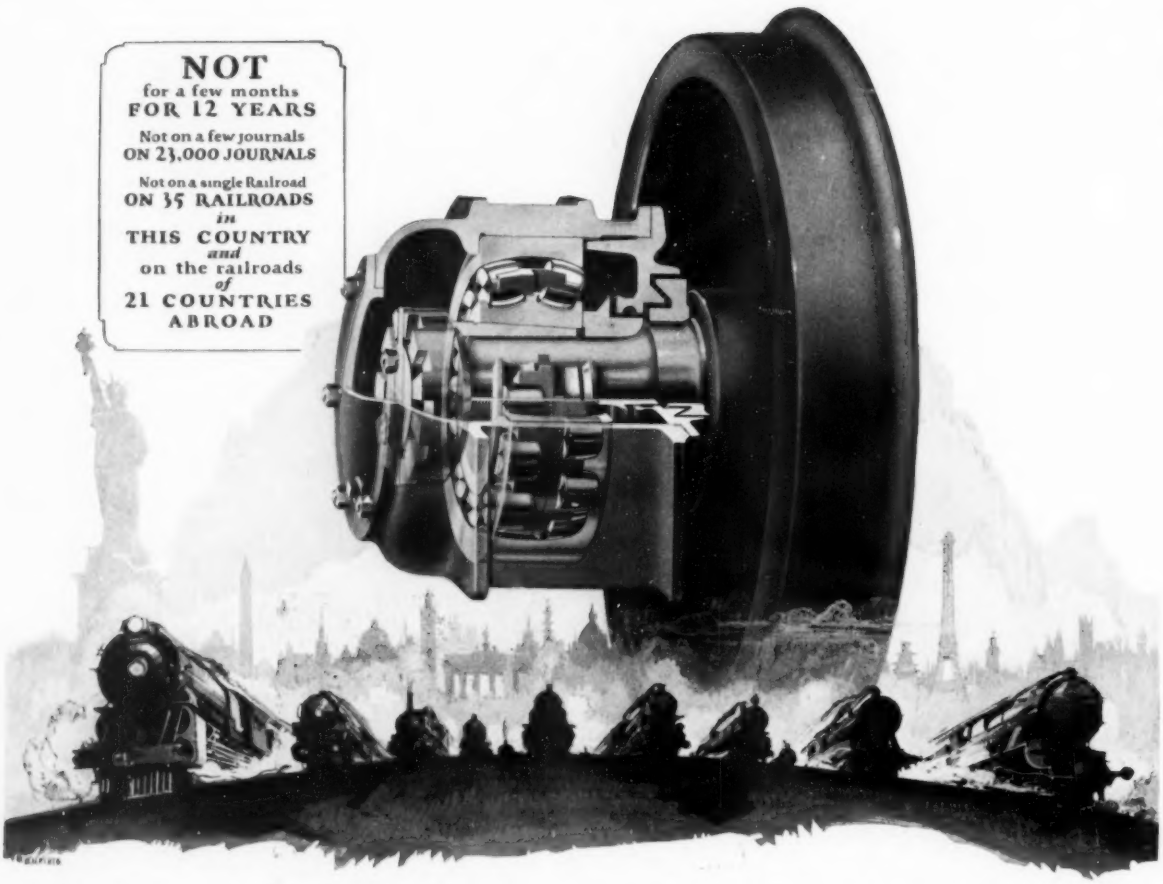

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IN THIS ISSUE

CONTENTS—JANUARY, 1928

Ancient Mayan Astronomy—By Herbert J. Spinden, Ph.D. 9
Studies of the Heavens by the Maya Indians When Rome was Young

Crash!—By Lieutenant George O. Noville 13
A Thrilling Account of How it Feels to "Crack Up"

Our Point of View—Editorials 16
Lindbergh; Sterilize Imbeciles; Vitalizing Rays; X-ray Movies; Weather; Ptomaine; Petroleum; Fakers; Floods

How Do the Life Processes Work?—By William Seifriz, Ph.D. 18
Reports of Researches into the Secrets of Protoplasm

From the Scrap-book of Science 22
Camera Shots of Scientific Events

Marconi Smiles on America—By Orrin E. Dunlap, Jr. 24
Wireless Inventor Visits Us and Discusses Radio

A Scientific Ghost Laid—By Henry Norris Russell, Ph.D. 26
Puzzle of Nebulium, so-called Element, Solved by Physicist

Successful Inventors, XIII—By Milton Wright 28
Concerning the Commercial Value of an Invention

Cricket Champions of China 30
Thousand-year-old "Fad" Still Grips Chinese Imagination

Underground Canal an Engineering Feat 35
Novel Link in New French Waterway

The Atmosphere—By W. J. Humphreys, Ph.D. 36
Researches into its Gaseous Content

The Month in Medical Science—By Morris Fishbein, M.D. 38
Review and Commentary on Progress

Plate Glass by the Mile 40
Success of the Endless Strip Method of Manufacture

Future Light—By M. Luckiesh 42
Past Progress and a Prediction

Will The Steam Automobile Return? 44
New Model Gives Promise of Renewed Interest

Tropical Telescope Making 46
Two Telescopes Made in Jamaica, British West Indies

The Origin of Cork Products 48
French Development of Cork Tree Cultivation in Algeria

The Red Hill Artifacts—By Dr. Cyrus N. Ray 49
Archeological Discoveries in Texas

Mountain Climbing by Air Cable 50
Suspended "Railroad" up Mont Blanc

Pay-As-You-Use-It—By Charles F. A. Mann 51
Individual Timer for Telephone Calls

The Month In Medical Science .. 38
- A New Automatic Blood Pressure Instrument 38
- Disease of the Joints 38
- Mineral Springs 38
- Rickets 39
- A Patient Without a Gall Bladder 39
- Spinach 39

Inventions New and Interesting 52
- Typewriter Copy Guide 52
- Bird Bath Lawn Sprinkler 52
- Emergency Rain Coat and Cap 52
- Door Lock Mortiser 52
- Steam Pipe-Cleaner 53
- Pliers to Find Break in Wire 53
- Electric Hand Plane 53
- Appointment Alarm Clock 53
- One-man Telegraph-Pole Lifter 53

Household Inventions 54
- Washing Bench 54
- Bottle Cork with Spray Nozzle 54
- Laundry Kit 54
- Oyster Rack for Plates 54
- Fruit Jar Grip 54
- Electric Egg Boiler 54

The Scientific American Digest . 55
- Roller Bearings End Jerking to Start Trains 55
- Is the "January Thaw" a Scientific Fact? 56
- Another Bit of Romance Destroyed 56
- Cathode Rays Speed Drying of Paint Oils 56
- X-Ray Photographs Furnish New Means of Identification 57
- Rust in Water Pipes Removed by New Method 57
- A New Way to Get Rid of Moles 57
- Precooling Fruits 57
- The Great Domes of Medieval Architecture 58
- Limiting Automobile Truck Speed .. 58
- Loader Straddles Railway Cars 59
- A New Field for Diesel Engines 59
- River Control Measures Threaten Pearl Buttons 60
- A Douglas Fir House 60
- Swedes to Make Sugar from Wood . 60
- Vaccination Exonerated of Causing Syphilis 60

Learning To Use Our Wings 61
- Spring Safety Stick 61
- "Time of Flight" Clock 61
- World's Smallest Balloon 61
- The Great Delusion 61
- Rohrback *Rocco* 62
- Apology 62
- Pressure Airships 63
- An Airplane Roller Skid 63
- A Motorized Kite Balloon 63
- Helium from Hydrogen 63

Strays From the Ether 64
- High Speed Attained by Marconi Beam 64
- Battery Receivers Can Be Electrified 64
- Who Owns the Ether? 64
- Much is Expected from the New Tube 65
- HHK on the Air 65
- Radio for Aircraft 65
- Antenna Formula 65
- Television in the Home 66
- Broadcasters Select "Nemo" as Radio Term 66
- Contribution of Women to Radio Styles 66

Applied Science for the Amateur 67
- Simulated Aura 67
- An Indoor Tractor Model Plane 67
- Unscrewing Rusted Threads 68
- More Photomicography 68
- Riveting in Blind Holes 77

Industries from Atoms 70
- A New Lead Hazard 70
- Wood Pulp Shot from Guns 70
- Protecting Water Mains with Cement Linings 72
- Tear Gas, Life Saver 72
- Synthetic Petroleum from Coal 72
- New Resistant Glass 84
- A New Wood Pulping Process 84
- Shirtless Sausages 86

The Heavens In January 74

In The Editor's Mail 78
- Partners Make Telescope 78
- Speaking of the Weather 78
- Our Error 80
- Mutual Appreciation 80
- The Foucault Pendulum Experiment 81

Commercial Property News 91
- Bringing Inventors and Manufacturers Together 91
- Mere Substitution is Not Invention 91
- American Inventions In Europe 91
- Don't Wait Too Long to Sue An Infringer 92
- Repairs May Constitute Infringement 92
- What Price Infringement 93
- Ireland's New Patent Law 93
- Hudson Tires and Cars 93
- Brazil Establishes New Trademark Bureau 93

Patents Recently Issued 92

COVER

This month's cover picture was painted by Mr. Howard V. Brown, our cover artist, under the instruction of Professor Spinden, who first suggested the subject and submitted rough sketches of the various details. The illustration depicts the ancient Mayan priest-astronomers at the Copan baseline, as the Sun sinks below the horizon in line with the distant western stela. A few liberties had to be taken with the surroundings. See the article starting on page 9.

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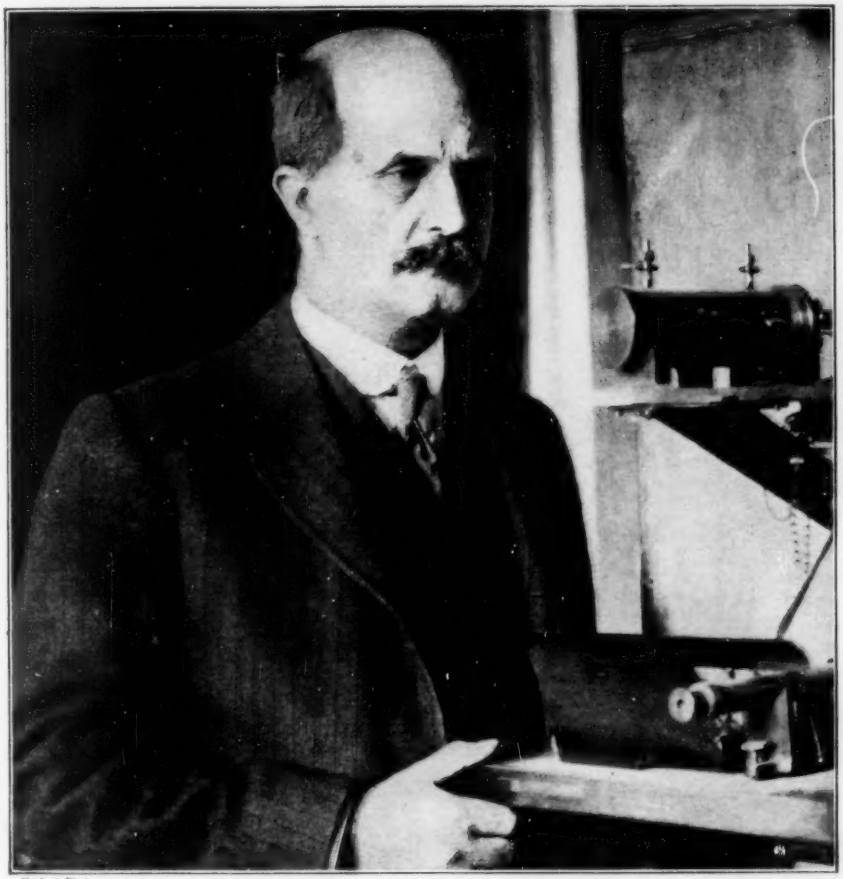


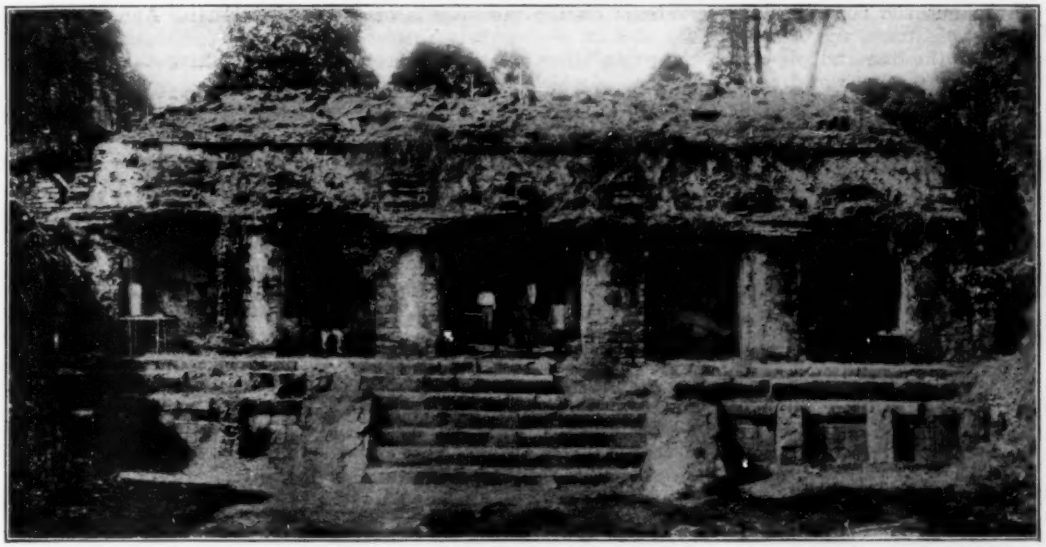
Herbert Photo

SIR WILLIAM BRAGG, F.R.S., D.Sc.

Like his distinguished son, Professor W. L. Bragg of the University of Manchester, Sir William Bragg gained wide fame among scientists because of his remarkably revealing researches on the atomic structure of matter. Working together, father and son were pioneers in the X-ray analysis of crystals. It had occurred to von Laue that if the atoms in crystals were arranged in as orderly fashion as was suspected, then the dimensions of their spacings ought to provide a good diffraction grating for X-rays whose waves are about ten thousand times shorter than those of light. The Braggs took up this work and their researches are now famous, jointly winning them the Nobel Prize. In his recent popular work, "Concerning the Nature of Things," Sir William Bragg explains the many marvels his discoveries revealed. He is Director of the Royal Institution, also of the noted Davy-Faraday Research Laboratory

Warrior Priests Before the Temple of Yaxchilan

WHEN the Spaniards started out, early in the Sixteenth Century, to conquer the Mayas, they quickly discovered them to be a most warlike nation and one not be to regarded lightly. In fact, had the Spaniards not possessed the advantage of cavalry and firearms, the conquest might never have taken place. The Mayas, never having seen horses before, and seeing the Spaniards astride of them, imagined the horse and the rider to be one animal which was able to make use of thunder and lightning. The Mayan army was composed of a sort of militia, a force which could be quickly called into service in time of need; also a "drafted" force consisting of the entire available manhood of the nation. Their chief weapon was the bow and arrow and the soldiers wore mail consisting of quilted fabrics filled with loose salt. The army leadership was peculiar, being dual. One head was a hereditary general and the other was a warrior-priest called a "nacon." Such leaders are the ones depicted on the tablet illustrated above.



A TYPICAL MAYAN STRUCTURE

A close study of this picture of a ruined palace at Palenque, Mexico, will serve to show how skilfully the Mayans performed their mason work. Oddly enough, they never discovered the curved arch principle which confers greatly added strength

Ancient Mayan Astronomy

When Most of Our Ancestors Were Untutored Barbarians, the Mayan Priest-Astronomers Had Developed Their Science to a Mathematical Precision

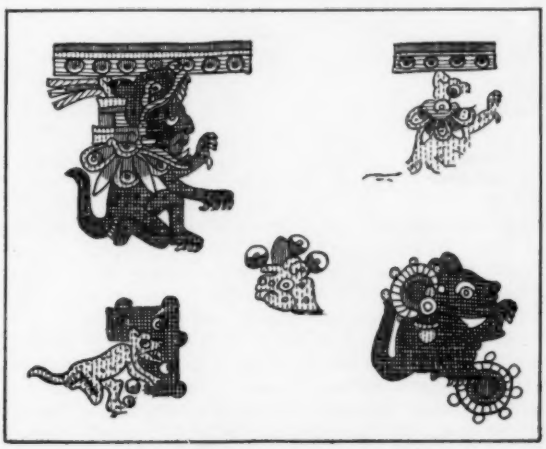
By HERBERT J. SPINDEN, Ph. D.
Curator of Mexican Archeology and Ethnology, Peabody Museum, Harvard University

¶ *This is the first of a series of articles on the remarkable civilization of the Mayas. The author ranks as one of the foremost authorities on Mayan research. In subsequent articles, other aspects of Mayan culture will be treated, and the author's experiences in Central America will be narrated.*—The Editor.

ASTRONOMICAL science, never entirely wanting in the culture of the most lowly people and often occupying a large share of attention among civilized nations, might easily be used to furnish an index of the intellectual power of group minds. That is, an intelligence test of the tribes, nations, and other masses of mankind might be prepared on the true knowledge possessed by these social groups of the movements of the heavenly bodies.

THIS would be a fair test because life itself depends directly upon the sun for matters of heat and light, while the duration of life is best measured by the celestial clock. Moreover, all the groups of mankind would have an environment of stars sufficiently the same. The phenomena of the day, the month, the year are unescapable and are recorded in all languages by special words.

But the reduction of these phenomena to patterns of re-coincidence is another matter and one that can be accomplished only after observations across the terms of many lives. Then there are the planets with real and apparent revolutions for eager minds to measure and reconcile, and the nature of time and space, and the designs of fate.



MAYAN STAR CONSTELLATIONS

The Mayas, like the Greeks, had their constellations. This is the Jaguar, variously represented. The circles are stars

IT is society that carries on, even though individuals make discoveries and elaborate proofs, and the intelligence of the social mind can be measured by the degree to which it holds and uses knowledge across the centuries.

Under such a test the Mayas surely would be certified as a people blessed with creative minds. In the first millenium before Christ they established in the wet Atlantic lowlands of Mexico and Central America a civilization destined to produce high art and remarkable

science. At about the time Thales, first philosopher of Greece, was observing the course of the Sun and planets and wondering how the world was made, a still greater astronomer lived in the region of the Yucatan peninsula.

THE ROUND TOWER

Built at Chichen Itza, in 1207 A.D. for astronomical observations. See opposite cut

The consummate scientist who invented the famous Mayan calendar may be nameless—unless he be the one call Itzamna—but personality greater than a name survives in his works. He seems also to have originated certain forms of ideographic writing which developed into an hierogiyphic system as the centuries rolled on, and a manner of keeping count which gave rise to a really wonderful notation of numbers. These things are closely involved in the Mayan calendaric idea which was surely an arbitrary invention and not a natural growth like most systems for correlating months and years. For his pains this unnamed astronomer was placed among his beloved stars as their eternal guardian and deified into a God of Time.

EXPLANATION of the complicated astronomical science of the Mayas is difficult in a short space, because very few persons have even rudimentary knowledge of Mayan hieroglyphs, or of Mayan numerical notation, or of several elaborate calendars based on the movements of the Earth, the Moon, Venus, Jupiter, et cetera, in which Mayan dates and calculations find their inner significance. Even to make a start, then, it is imperative that my readers agree to plunge into the midst of a dark and unknown subject, keeping some questions for later answerings.

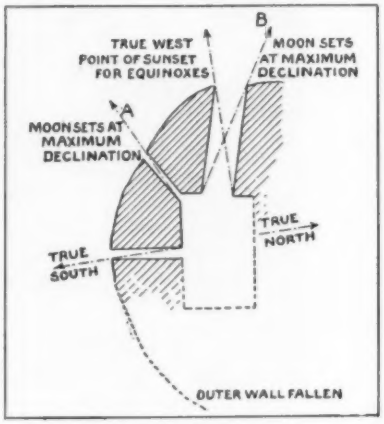
In addition to making ordinary observations on the movements of the moon and on the equinoxes, solstices and certain other points of a farmer's almanac—of which a legible record still remains in the arrangement of monuments and in inscriptions carved on these monuments—Mayan astronomers were accustomed to observe the heliacal risings and settings of various stars and planets. That is, they noted the first and last appearance of the star or planet in question in the glow of sunrise or sunset. Also they may have observed the first risings or settings in opposition to the sun, but on this point good evidence is lacking.

NOW the intervals between heliacal risings of a star ultimately yield the length of the sidereal year, as opposed to that of the 20-minute-shorter tropical year of the equinoxes, solstices and seasons, and the same intervals for a planet give the length of its synodical or apparent revolution. It is quite possible that the Mayas had also come to know the sidereal times of certain planets, a much greater achievement than finding their times of apparent revolution.

There are two reasons for believing this: first, because they used in their calculations certain natural cycles in which the Earth, the Sun and a planet, say Venus, return to the same relative positions in the sky; secondly, because they used a form of zodiac or scale of constellations by which the progress of a planet across the starry waste could be marked throughout the entire year.

As early as the sixth century B.C., the Mayas discovered a highly serviceable natural cycle for the Earth, the Sun and Venus—highly serviceable in spite of the fact that it carries an accumulating error. This natural cycle consists of five apparent revolutions of Venus, thirteen sidereal or true revolutions of the planet and eight years. Actually this means that the fast-moving Venus in making thirteen laps around the Sun gains five laps on the slower Earth. And whenever she gains a lap she comes out in front of the Sun as the morning star and has her heliacal rising.

It hardly seems possible that the Mayas understood about the thirteen



A CROSS-SECTION

How the openings in the Round Tower were used by the Mayan astronomers for sighting

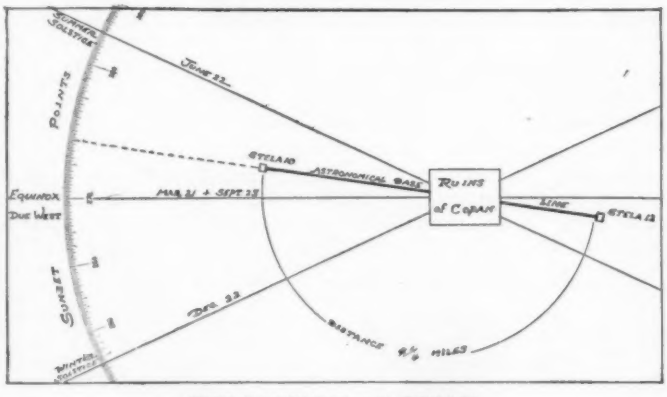
sidereal turns when they first observed the coincidence between eight "Earth" years of 365 days each and five "Venus" years of 584 days each. But they found out that the sky machine did not run exactly true to formula and after a while they began using another cycle based on the practical coincidence of 243 years, 152 apparent revolutions of Venus and 395 true revolutions.

Then they found a still longer cycle of 1506 years which brought the heliacal appearances of Venus back to the same position in the natural year and the same position in the Mayan calendar.

THESE matters will be explained more fully in another place. Here they are cited merely to show that the Mayan astronomer-priests had a pretty fair notion what Venus was up to.

Their state of knowledge is still further disclosed when we find them carving on temple fronts hieroglyphs showing Venus in conjunction with constellations lying along that planetary boulevard which we call the zodiac.

The Mayan zodiac is pictured in one of the three books of this gifted people which escaped destruction at the hands of the Spanish clergy. This zodiac has thirteen parts instead of the twelve parts of our own arrangement, each sign being an animal or bird or other object identified with a constellation. In connection with this zodiac they



THE BASELINE AT COPAN

The priest-astronomers depicted in the front cover picture were situated at the spot marked "Stela 12," looking toward Stela 10 at sunset

used a year of only 364 days divided into 13 parts of 28 days each.

This "ritualistic" year of the Mayas is the same time pattern now being considered for a new business calendar of even weeks and equal months. For them it was probably a formalization of 13 sidereal months. The zodiac is drawn in two parts and each sign or animal holds the Sun in its mouth. We are able to reconstruct some of this zodiac among the stars: the Rattlesnake Constellation has the Pleiades for rattles, while the eye of the serpent is Aldebaran in Hyades. The group known as the Turtle was formed by certain stars of Gemini. Then came the Constellation of the Scorpion, plainly different from our own star group of the same name. The brilliant star Regulus was probably called the Eagle in Central America.

MAYAN monuments often picture rulers on celestial thrones covered with a canopy of heavenly bodies. On these monuments there is generally a man in the center of the Sun and a woman in the Moon. The planets have their special symbols. From other sources we gather that the Mayas and the Mexican tribes imagined the universe as consisting of various celestial and infernal planes with the Earth stretched between these two.

We find abundant evidence on the prefiguring of space and time in the illuminated manuscripts made by neighbors of the Mayas but generally reflecting Mayan ideas. But the Mexican Sun is differently drawn with rays, and in elaborate representations is like a shield surrounded with eagle feathers and set with turquoise mosaic. The Moon is a deep crescent usually holding a rabbit.

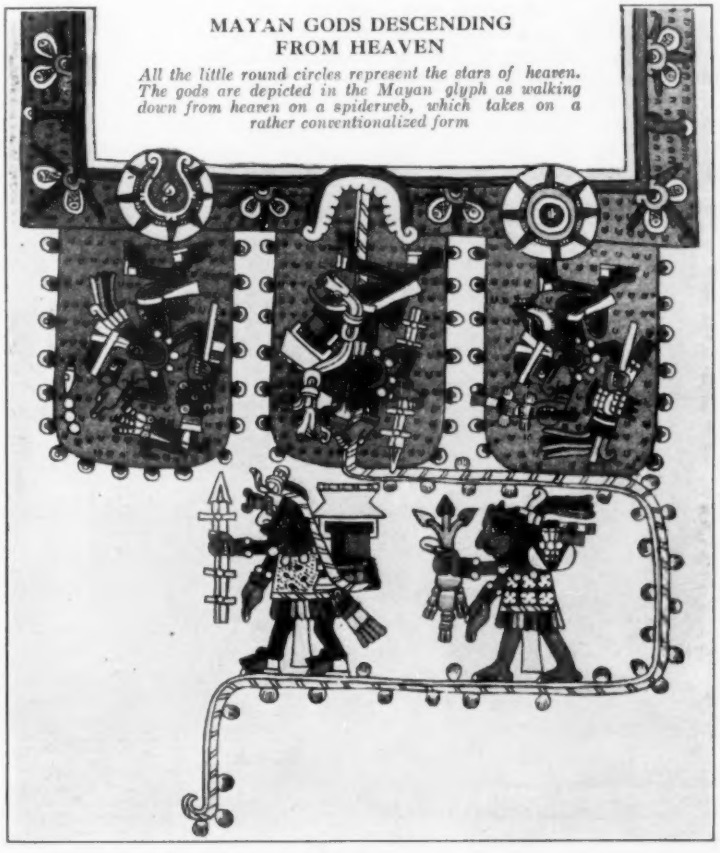
Stars are not drawn in accordance with our own five pointed figure, but as eyes in heaven. Shooting stars are tailed eyes. Great stars are sometimes shown with beams, but even then there is an eye in the middle of the design. Also the wheel-like symbol of precious jade is used for very brilliant stars. Constellations are frequently pictured by animals, birds, et cetera, surrounded by eyes or carrying a great star symbol. We find numerous representations of the Jaguar Star or constellation, the Rattlesnake, the Ball Court, et cetera. I furnish examples of some of these.

MAYAN ASTRONOMERS SIGHTING ON STARS

At left, crossed sticks for sighting. In center, two similar pairs of sighting sticks, and at right an eye behind sighting sticks. The same "gunsight" method was used in Europe until the 17th century

MAYAN GODS DESCENDING FROM HEAVEN

All the little round circles represent the stars of heaven. The gods are depicted in the Mayan glyph as walking down from heaven on a spiderweb, which takes on a rather conventionalized form



Also in Mexican manuscripts, and especially in the Bodleian, Selden and Zouche codices, we find indications of the methods of observation. Now, among the questions always asked are these: How could a people without the telescope or even the astrolabe reach marvelously accurate results for such a vague thing as the true length of the year? How could they construct tables by which eclipses might be foretold? How could they follow the movements of planets and find approximately the values reached by modern science for their movements among the fixed stars?

THE answer is briefly this: the scientific perfection of Mayan astronomy is explained not alone on the instrumental side, although these Indians did have rather precise methods of observation. Instead it is explained by the full and concise records which they kept and the general effectiveness of their mathematics. It seems that they started on August 6, 613 B. C. (the dates used in this article are on the Gregorian calendar projected backward, and the first year before Christ is numbered zero), to write down a serial count of days and what happened on these days. After a thousand years or so they accumulated an ephemeris of past performances of the stars so arranged that they could tell the exact number of days between recurrences of any phenomena. It was this device of the day-count that gave the Mayan astronomers their ability to strike very accurate mean intervals. Another such day count was invented in 1582 A. D. by Scaliger, the chronologist.

A method of observation used in Central America was to set up a crotch in the darkened chamber of a temple and sight through it at the star. Presumably another point on the line of sight was noted, perhaps a mark on

the horizon. The Pueblo Indians of New Mexico use to this day a somewhat similar method in connection with the Sun. From a fixed place of observation they mark the points of sunrise and sunset at the solstices by what they call "Sun houses." They say that the Sun rests for several days in these houses before beginning the reverse journey.

A CONGRESS OF ASTRONOMERS AT COPAN

The astronomers are considering an important key date. Where so much depended on the calendar count, astronomers were the most important members of the community

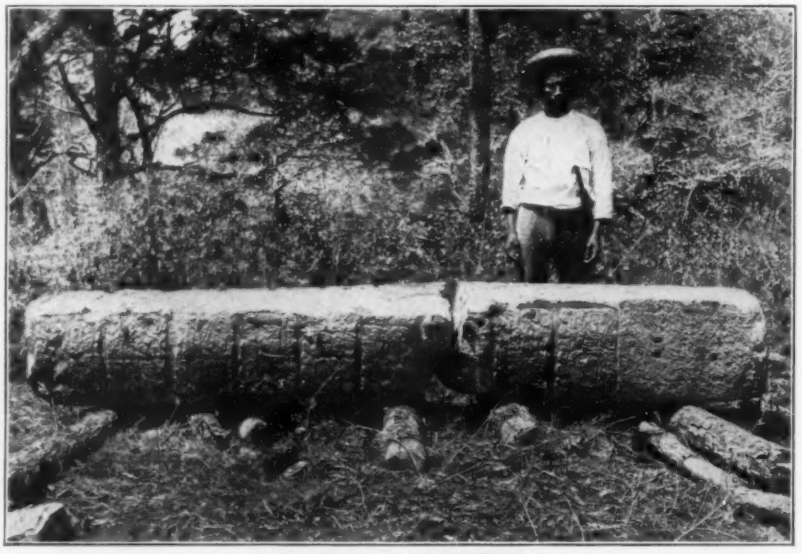
In some of the pictures in the Mexican codices the star or other body is descending into a notch or rising out of it—a good example of this I give from the Bodleian manuscript. Two men face each other and between them we see the eye in the crotch and in the distance a jade star sinking into the second notch.

VERY often temples in the manuscripts are surrounded by starry eyes or carry one of the more complicated symbols of a brilliant orb. Fortunately we do not have to depend solely on these naive pictures in the matter of ancient observatories.

The most remarkable of these observatories is located at the Mayan city of Copan in western Honduras. On opposite sides of the valley in which lie the ruins of the city are two monuments over four miles apart. (Note: See cover illustration—EDITOR.) When first found, these monuments, called the Painted Stones, were supposed to mark an east and west line across the city. At the time of the Peabody Museum Expedition to Copan the line was ascertained to run slightly north of west. In 1916 this was resurveyed, and again in 1926 by the Carnegie Institution of Washington. The readings vary slightly, but, in so long a line as this, this variation becomes important.

As viewed from the eastern stone the Sun sets behind the western stone twice during the course of a year, one occurrence being about the same interval after the vernal equinox that the other is before the autumnal equinox. It seems from the dates on these two markers that the base line was first arranged in 392 A.D. to reach April 5 and September 6. The dates are also those of new and full moons, so there was a correlation between Sun and Moon in the farmer's almanac of the Mayas. Other monuments at Copan show that the base line was reset first to yield April 9 and September 2, and secondly to yield April 12 and August 30, which are the dates recovered by the last survey.

There are two important monuments in the city proper which carry the matter of interlocking dates of the Moon, Venus, and the year of the seasons much farther. One of them is Altar U which begins by recording two "new years" days on April 9. Now the Mayan chronicles say that Pop (the first month of the Mayan year) was "set in order" in a particular time period in the distant past. The dates on this monument fall in this period. It seems there was a scientific congress of astronomy called at Copan to settle a number of momentous questions of the calendar.



A TYPICAL MAYAN STELA

Formerly in an upright position, it toppled over. To the same fortunate accident which preserved the glyphs on their faces is due the preservation of many other stelae or monuments

The other monument, Stela A, records an inferior conjunction of Venus with the Sun on April 5, 471 A.D. The planet then had its heliacal rising on April 9 and it happens that the new year day at this time was just three days afterwards, or April 12. This latter is the outstanding date in the Venus calculations. It will be possible to dicuss some of these dates and their interrelations more fully after the Mayan way of writing dates has been explained.

ANOTHER observatory of a somewhat different kind has been excavated at Uaxactum in northern Guatemala, a ruin with monuments covering 561 years of occupation from 68 to 629 A.D.

Still another observatory is the famous Round Tower of Chichen Itza, supposed to have been erected about 1200 A.D. by Quetzalcoatl, a Toltec conqueror much taken with Mayan science. Oliver Ricketson, who developed the readings at Uaxactun, also found that the three windows which remain in position in the second story of the Round Tower give true west and true south on their diagonal lines of sight, and that two other such diagonals find the positions of moonset at significant times. The true west observation furnishes the point of sunset at the vernal and autumnal equinoxes. Another shows where the Moon would set at maximum declination of this variable orb when its ascending node is at the vernal equinox. The nicely made window-jambs of the Round Tower must, then, have been carefully built into place after astronomical angles had been determined by observations.

(To be Continued)

Crash!

A Veteran Aviator's Impressions After Cheating Death Several Times in Airplane Accidents

By LIEUTENANT GEORGE O. NOVILLE

Flight Engineer, America; Third in Command, Flight Engineer, Byrd North-Pole Expedition

WHAT does a flier think about when he knows he is going to crash—or "crack up," as we say? Well, that all depends on how much thinking time he has.

There are two kinds of crashes, so far as the flier's mental attitude is concerned. In one case he has not much time for thought and his actions are instinctive. In the other kind of crash he is amply forewarned, and he has plenty of time to muse upon the joys of life and consider philosophically the sweet advantages of being elsewhere; and he has time to make whatever preparations he deems necessary to cheat death when his plane comes into violent and unavoidable contact with the earth.

It has been my good fortune to live through the experiences of both kinds of crashes. I say good fortune because there is not a more glorious experience than that of having a kind fate give back a life which seemed lost. It is literally the same as being made a present of one's own life. And there is nothing more glorious than the days which follow a narrow escape from death.

But the minutes or seconds during which one faces death are not so pleasant. Peculiarly, however, time becomes terribly confused in such an instance, and what may seem years may be actually two or three seconds; and what is actually two or three hours may seem as a flash through the mind.

FOR instance, when the monoplane *America* which was later flown across the Atlantic, "cracked up" at the end of a test flight at Hasbrouck Heights, New Jersey, I knew for the fraction of a second before she stood on end that the crash was inevitable. But that fraction of a second seemed to be a condensation of at least a century. On the other hand, when we were flying about blindly in the fog over France after crossing the Atlantic from New York, there were at least three hours during which we realized that in all probability we would die before dawn unless the weather cleared. Those three hours, as I recall them vividly now, seemed to consume only a few seconds, as our minds raced along seeking to provide some bulwark against the inevitable crash.

It is probable that the crew of the *America* on that flight faced, longer than any other fliers, the certainty of a "crack up," with an excellent chance of losing their lives in the crash.

FOR about three hours our minds were subject to dreadful uncertainty. We were flying in a blind fog and rain and did not know just what would happen; but three hours later we knew *definitely* what was going to happen. We had to land, and landing meant crashing. Of that there could be no doubt. Whether we could possibly survive the crash was a matter for speculation, although the sum total of my own thoughts was that we would never see daylight again.

Soon after we crawled from the sea at Ver-sur-Mer, wet, exhausted, and stunned, Commander Byrd and I were seated before the welcome fireside of the lighthouse keeper. The commander asked me:

"When we were up there blind in the fog, and you knew we had to land soon, how much chance did you think we had of coming out of it alive?"

I answered that I believed death had an edge on us of 200 to 1.

It is not often that a 200 to 1 shot wins. A man condemned to the electric chair has a better chance than that, for out of every 200 condemned men, quite a few have their sentences commuted. So, for almost three hours, we were worse off than a man in the death house at Sing Sing—with this important difference: the condemned man can do nothing but wait stoically during the last moments of life, while we could busy ourselves in preparations for trying to cheat death.

There was no question of resigning ourselves to death. On the other hand, we keyed our minds and bodies to take advantage of the one chance in 200.

I cannot vouch for the others, but I will admit frankly that I was scared. By no means did I approach the adventure of a crash with any pleasurable, heroic thrill. If there was any glory in going down to death after flying the Atlantic, I did not crave it. It was not a question of assuming the heroic attitude of, "Let death come. I am ready." I certainly was not ready, and inside that ship was exactly the place I did not want to be during those hours in which we hung between life and death. But there we were, and that was that.

Here was the situation: We had flown from New York to France. We had been in the air about 35 hours, when shortly after flying over Brest we discovered that our compasses had been put out of order by electrical disturbances in the atmosphere, and we had gone off our course many miles in a jelly of fog and rain through which we could not see our wing tips.

GETTING our bearings and locating ourselves was a difficult task for Commander Byrd and even if we had our bearings, even if we had been immediately over a landing field, we could not have come down without a strong possibility of crashing, because to make a favorable landing, one must know where the ground is. And we did not know the location of the ground or anything else.

The *America* was like a great eagle suddenly gone blind and crazy in the air. As I look back on the whole thing

All Photographs by Wide World

FOUR INTREPID AERIAL ADVENTURERS

Left to right: Noville, author of the accompanying article, Commander Byrd, Acosta and Balchen, on the morning after their now historic crash in the sea just off the coast of France

in detached fashion, I feel an overwhelming sense of pity for the great plane, lost in the black sky; exhausted and seeking a resting place, yet afraid that rest meant death. In my memory the roar of the engines becomes a forlorn, importuning whine, like the melancholy whimpering of a scampering little dog in search of his master.

But to us in the plane at the moment there was no hint of pity for ourselves, much less for the plane. Here we were in a rather unpleasant situation, and we bent every effort toward getting out of it. It was a situation which all of us had faced before, although never to such a high and prolonged degree.

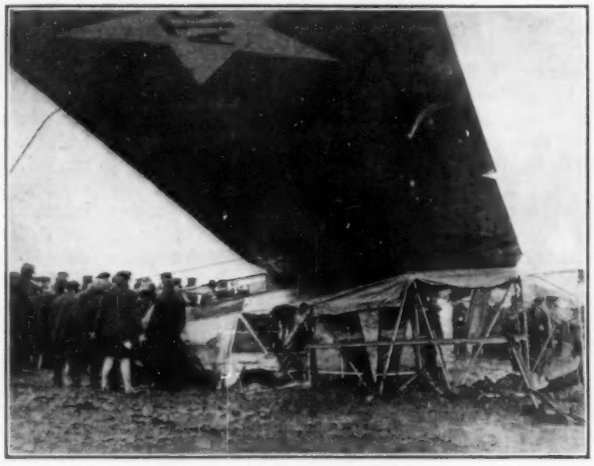
TO make our mental reaction doubly bad was the fact that we were within easy striking distance of our goal when we discovered that we were off our course. We had already crossed the ocean which in the general opinion was the most dangerous and trying portion of the journey, and apparently all we had to do was sail into Paris. The sudden interruption of this schedule was a real shock, as can well be imagined—the same sort of feeling that comes to a football player when he has a clear field ahead and then trips and falls on the one-yard line. It was a bitter disappointment to all of us, because we were all set for the landing.

The dirty work was all over, so I had already taken off my grease spattered "teddy bears" and was looking forward with the keenest anticipation to a good French meal and a good night's rest. A period of almost two days in the air makes such simple things look large, and to have them vanish just at the hour of achieving them, was a cruel blow.

For three or four hours after we were suddenly cut off from an exact knowledge of our whereabouts, we had hopes that we would run into a clear spot somewhere and possibly get our bearings from the ground. It seems to be in the nature of a flyer that he never gives up hope. But lives cannot be saved by hope alone. We had to do something. We ducked the plane down several times, looking for anything we could see, but we were stone blind in the fog.

A reading of the gas gage showed we had sufficient fuel to remain in the air three hours more. That meant we must come down voluntarily before four A.M., before day broke, or we would come down involuntarily. About one A.M. Commander Byrd went into his cabin and sat down. Fifteen minutes later he handed me a note. Perusing it carefully, I read as follows:

"It would be extremely dangerous to land on terrain. From our observations, France is dotted with little villages and it would be almost impossible to land without endangering the lives of the people below and probably kill some one. Consequently we will find the nearest water and land there."



LIKE A WOUNDED BIRD

The monoplane America, *after it was removed from the sea following its plunge at the end of its successful transatlantic flight*

If you want to know about the mental and emotional reaction of a flyer facing an inevitable crash, just read that note again. We were men who had set out on a somewhat dangerous journey, knowing what we were doing and willing to take the risk, but innocent bystanders must not be endangered. That is Commander Byrd's creed—to give first thought to others.

ANYWAY, the die was cast. There was no longer any uncertainty about what we were going to do, or at least *try* to do. Sometime within the next three hours we would set our 8000-pound plane down on water at the speed of 45 miles an hour—not a pleasant prospect.

When the decision was made known to us, we took it in the spirit of, "Well, that's that." There was no panic, no confusion. Our only thought was to find water, turn the plane's nose down, and see what would happen. The Commander pored over maps, trying to figure out the safest place in the Channel in which to make a landing. And let me say here that it is a marvelous tribute to Commander Byrd's navigational sense that even in our blindness his judgment was correct.

Knowing that we would need all our strength for the emergency ahead, Commander Byrd and I lay down a while on the cabin floor for a few minutes' rest.

I closed my eyes in deep thought, mainly trying to figure out how our ship would act when she hit the water, and what would be the best way of meeting the crash. In the meanwhile the needle of the gasoline gage was going down and down, like a clock ticking off the last few moments of life.

Soon we were actually facing death. We sighted the lighthouse at Ver-sur-Mer, not being certain of its relative position to the shore line, and not knowing that it was well inland, for the short beams of light were all but hidden in the fog.

COMMANDER BYRD and I were in the cabin. In front of us was the navigator's table. Should the impact of the crash throw us against its sharp edge, serious injury would result. Its legs were of iron tubing and it was lashed in with heavy strips of leather. In accordance with our prearranged plan, in the event of a crash, this must be torn out. At the Commander's signal, we heaved and tore until it broke loose—then it was thrown far back in the tail. The Commander and I then began to rip out the windows in the side of the fuselage so that we would have some means of exit when the plane started under water. All our thoughts were of having a means of escape when we hit.

We then took our places, one of us at each window, Balchen at the controls with Acosta by his side, and waited. Suddenly the big plane banked and turned to get into landing position. The engine on the upper side sputtered for lack of gas. I looked at the altimeter. It registered zero, and since it is accurate only within 100 feet, I knew we could not be more than 100 feet above water—or land. The nose was turned downward.

It was now a question of seconds. We were going down to—we knew not what. Perhaps we were living now through the last moments of life. But I did not experience that kaleidoscopic flashback of the events of my life, which is popularly supposed to occupy one's last seconds. I was thinking not of the past, but of the future.

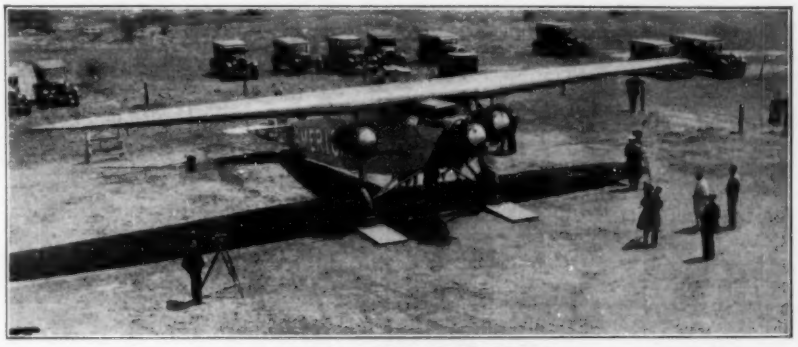
I braced myself for the crash. I did not want to be thrown headlong into the gas tank ahead, although fortunately it was made of soft brass. I also tried to place myself so that I would not be run through by a broken strut. I tried to figure out what the big ship would do. Would she hold together, or would she crumple up with the first impact and leave us trapped in a prison of twisted metal? Would the gas tank be jammed back and cut off our exit? How far under the water would we go? Would we be knocked

unconscious and drown before we could get out?

Those are the thoughts that raced through my mind in a fraction of a second. My mind was clear, far more alert than under ordinary circumstances. The instinct for self-preservation entirely overcame fear. We must be ready to think and act quickly.

Commander Byrd dropped a flare. The big ship slowed down. Then came that fearful whine of the wind rushing through the wings when a plane sinks. I looked out of the window. I could see nothing. We were going down into an abyss. I grabbed for my flashlight. Then we hit.

THE commander was hurled out the window head first. All I saw was his boots vanishing through the open space—just like a character in a comic strip. Then the water rushed in and twirled me into a series of somersaults. That moment was the most fearful of all. I thought I was trapped under the water, to drown like a rat; and I have always had a horror of dying in a trap. Instinctively I thrust out my hand, feeling for the window. I found it, pulled myself through and shot up above the surface into a dead, eerie silence. I was stone deaf because of the constant roar of the motors in my ears.



WARMING UP THE MOTORS

The transatlantic monoplane, America, with motors purring smoothly, waiting to take off on a test flight before her last "hop" across the treacherous ocean toward the shores of France

ON THE BEACH AT VER-SUR-MER

Commander Byrd, as related in this article, decided to land in the water of the English Channel, rather than risk coming down on unknown land and probably harming people on the ground

That was the most peculiar sensation of all, this utter absence of sound, as if I had been reborn into a world without sound.

But there my story ends. I have told how it feels to crash, and what goes on in the mind of the flier when he has sufficient opportunity to think it over. But the peculiar part of the whole thing was the fact that those four hours of uncertainty, followed by three hours of certainty that we would crash, seemed to pass in a moment, whereas just a few months before we had cracked up on a test flight at Hasbrouck Heights, New Jersey, we had a warning of only a second or so, but that flash seemed a century.

Anthony Fokker was piloting the plane. Commander Byrd, Floyd Bennett and I were all riding up in the cockpit. We had just made a beautiful flight of 40 minutes. In landing the wheels touched the ground and bogged down in a soft spot, but the tail would not come down. Immediately we knew that the nose would dig into the ground. That meant a "crack up," and probably fire. For 30 yards we skimmed along the ground with the tail up, and then—*crash!* It does not take long to cover 30 yards, so you can see how much warning we had. There was no time to do anything, but it seemed ages before the nose ripped into the soil. Bennett was caught under the engine. Commander Byrd's wrist was broken. It seemed to me that I was cut in two. Mangled as he was, Bennett's first thought was of the other members of the craft's crew.

"Look out for fire," he yelled.

But we were powerless to move. Any second we expected to see a burst of flame. But fortunately the wreck did not catch fire.

The gasoline tank burst, however, and the oil pipes were torn so that the warm thick liquid began to drop on me. I thought it was blood. I have often laughed about that since. We all got out with our lives; that's the main point.

BUT the greatest scare I ever got in the air involved no real danger at all. It was during a test flight of the *America*. Bert Acosta was at the controls, and I was sitting beside him. We were almost a mile in the air when I got up from my seat to have a look around the cockpit. The seat is so placed that when you get out of it, you have to take a step backward. I took the step backward and stepped right out into space.

For a moment I plunged downward, as if starting on a sheer drop of a mile through the atmosphere. Then I recovered myself to find that one leg was out in space, jammed against the bottom of the plane by the furious wind, but my body was caught fast. I had stepped through an open trapdoor which had become unfastened in the bottom of the ship. Perhaps I have my rather large girth to thank for the fact that I did not go on through. At any rate it was the greatest "kick" I ever got in all my air experience. It was a thousand times worse than being plunged unexpectedly into ice cold water.

Acosta, with his peculiar airman's sense of humor, laughed at something he considered very funny—but I can assure you it was not, at least from my point of view.

¶ *"Doc" Kinkade, well-known aviation engine expert, has prepared especially for* SCIENTIFIC AMERICAN *two articles of vital interest. The first of these will appear next month.*

Our Point

TRUE TO FORM

IN accepting the position of consulting expert for the Guggenheim Fund for the Promotion of Aviation, Colonel Lindbergh has shown once more those sterling qualities of character that have endeared him, not merely to his native America, but to the peoples of all the earth. Truly magnificent was that lone and unerring flight from New York to Paris; magnificent, also, was the modest dignity with which he accepted applause which, in its spontaneous and universal sweep, never before had been accorded to any single man; and magnificent was his unflinching refusal to capitalize his flight by selling himself to those professional exploiters, who offered him all the kingdoms of the world if he would but gently bend the knee to Mammon.

In this money-mad world it is inspiring to hear this young man call the world back to the aims and spirit of an age when men believed that high thinking was finer than high finance; to an age when there were men in our midst who had not altogether lost the spirit of Him who exclaimed: "What shall it profit a man if he gain the whole world and lose his own soul?"

We hear a good deal these days about decline of the true professional spirit. It may well be that there are those among the dollar-chasing crowd who wonder what people mean when they talk about the true professional spirit. To such we say: study the bearing and conduct of Lindbergh from that hectic hour of his arrival on Le Bourget field, to his final acceptance, in spite of the allurements of wealth, of an aeronautical expert's position in aviation—and you will find the answer.

STERILIZE THE UNDESIRABLES

THE Supreme Court of the United States has been called upon to pass on a case resulting from the Virginia sterilization law. Under that law, a sterilization operation was performed on an 18 year old, feeble-minded woman, who was the daughter of a feeble-minded mother and the mother of a feeble-minded child. The Virginia law permits the superintendent of the state colony for epileptics and feeble-minded to cause operation to be made when it is his opinion that it would be for the best interests of society, but only after complying with numerous safeguard provisions.

In its decision, the highest Virginia court pointed out a fact which everyone could see, were it not for the intervention of sentiment; namely, that since the state may in case of need (war, riot, et cetera) call on the best citizens for their *lives*, it would be strange if it could not also call for this lesser sacrifice. "Three generations of imbeciles are enough," says the Virginia Court, and the United States Supreme Court upholds that sentiment.

As the Mendelian law of inheritance makes evident, and as experience makes equally so, the sterilization of all the feeble-minded would not do away with feeble-mindedness, since most of us are potential carriers of feeble-mindedness through the germ plasm or other medium. Nevertheless, it would accomplish the reduction of that quality to a comparative minimum. Most of the crime which directly and indirectly costs the country billions, is committed by not more than 5 percent of the total population, the majority of these criminals being feeble-minded and the quality of feeble-mindedness being inherited, acquired from environment or both.

How long will modern society put up with this 5 percent and permit them to reproduce their kind? Residents of other states will profit by keeping an eye on the success of the procedure in Virginia.

A New Revelation

"BEYOND all reasonable doubt," says the Bureau of Standards, "all the new glasses now being marketed for transmitting the ultra-violet 'vitalizing' or 'activating' solar rays, at 290 to 310 millimicrons, undergo a photochemical action and decrease greatly in transparency to these activating rays when exposed to ultra-violet radiation.

"Glasses which transmit 15 to 25 percent at 280 millimicrons when new, decrease in transmission to less than 5 percent . . . after a few hours exposure to the mercury arc or a few weeks to the sun."

The Bureau thinks that these glasses "probably" still retain sufficient transparency to the vitalizing rays for therapeutic purposes, but it points out that the minimum limit will require further investigation by biologists.

The revelation of the Bureau tends to put a new complexion on the whole subject of vital ray glass. Certainly we have heard nothing about this deterioration from the manufacturers of the glass, in which a rapidly growing trade has sprung up within the past year or two.

We expect to have more to say about this interesting little denouément.

X-RAY MOVING PICTURES

IN England they have been showing motion pictures taken with the aid of the X ray. Bone movement and the beating of the heart at normal speeds have both been shown vividly on the screen. The uses for educational and diagnostic purposes are at once apparent. It may even be there are industrial uses; perhaps some scientist may some day watch just what is happening inside a cow when grass goes in at one place and milk comes out at another.

THE LAST LAUGH

THE past summer did not reward its prophets. Three years ago, two unofficial meteorologists, Mr. Herbert Janvrin Browne, of Washington, and Mr. H. H. Clayton, of Massachusetts, began predicting that 1927 would resemble that famous year of 1816, still remembered as the "year without a summer." Now comes our turn to laugh.

The summer of 1927 came and went, and only after its advent were accurate, systematic day-by-day and hour-by-hour records available. After a detailed study of these records, Mr. Alfred J. Henry, Editor of the *Monthly Weather Review* published by the United States Weather Bureau, states that, while the summer of 1927 was out of the ordinary run of summers, the month of August having been one of the coolest months of the name in the last fifty-odd years, the summers of 1903, 1907 and 1915 were about equally cool, 1915 actually being cooler.

In the first place, the records for 1816, the much-talked-of "year without a summer," pertain only to New England; elsewhere they were not kept at that early date. Had they been, it is not impossible that the figures for the rest of the area between the two oceans would have offset the frigidity of New England. However, if we insist on regarding New England weather as a criterion for a year without a summer, then, according to Mr. Henry,

# of View

there have been subsequently 29 or more cooler summers than that of 1816! So much for the trustworthiness of an ancient tradition.

At New York, the month of August was admittedly wet and cool, and this condition obtained over at least three fourths of the country. It may have been the four-degree subnormality of that month in one particular locality that provoked our good friend, Dr. E. E. Free, to rush into print in a metropolitan daily with a claim that the long-range weather predictions of Messrs. Browne and Clayton were vindicated, a claim which was subsequently reprinted in the *Literary Digest* and thus spread before millions of readers throughout the nation.

Now it is a fact that most of us are more mindful of the weather as it is than as it was. When it is winter we wish it were summer, and when it becomes torrid we long for a snowstorm. Last impressions are the strongest. One frigid day wipes out the memory of many warm days. Many of those whose nerves became a little frayed by the pure cussedness of the month of August were therefore in a receptive frame of mind to believe that 1927 was really turning out to be the prognosticated summerless year.

But Weather Bureau statistics are impartial. They ignore our general impressions. The meteorologist does not simply say, "Oh, I guess that on the whole this has been a cold month." He accurately adds up daily and hourly records just as an accountant refines his sums to a penny. And so from the *Monthly Weather Review* we get the following facts concerning the summer of 1927: For June, July and August the weather of the United States averaged three degrees below normal; or, if we choose the astronomical summer from June 21 to September 21, the depression below normal average just *one degree*, Fahrenheit!

The weather guessers allotted too much weight to the hectic month of August. They should have remembered the old proverb: "It takes more than one swallow to make a summer."

FABLES

YOU may now forget to worry about the risk of poisoning from the linings of tin cans. Chemists of the United States Department of Argiculture have proved that tin has absolutely no effect on the human body. They fed tin in two-gram doses to human beings for five days, made refined analyses, found no trace of tin in the blood stream—no tin had been absorbed by the body. Thus is another imaginary ghost laid.

This puts the tin-can menace in the class with the source of the greenness of green tea, dried, according to a fable that will not down, on copper plates, hence the green color. This sounds reasonable enough, only it is not at all the truth.

Well, then, tell us why green tea *is* green. Pick a batch of tea leaves, let them stand and ferment slightly, dry them—black tea. Pick another batch, dry them immediately—green tea.

The Flood Peril

WHEN Congress is about to wrestle with the flood problem in the Mississippi, it is confronted with a scarcely less appalling series of flood disasters in the sweet and untroubled valleys of New England. With no further warning than overcast skies and rather persistent rains, the death-dealing floods came sweeping through town and hamlet, wiping some of them practically out of existence and taking a toll of hundreds of human lives. And so the country finds itself confronted with two major physical problems calling for immediate and adequate action, if our fair lands and our good people are to be made permanently secure against the loss of home, lands, and even life itself. First and last, all this is a problem for the engineer. If Congress is wise, it will put the solution entirely in his hands and fulfill its own part of supplying the funds for construction as they are called for.

LEGISLATION TO SAVE OIL

IN spite of the many warnings by oil men who speak with the voice of knowledge and authority, the wild and greedy scramble to suck our rich oil deposits up to the surface and turn them into cash goes on apace. Our surpassing wealth today is to be credited, more than anything else, to the lavish way in which nature has endowed the United States with valuable national resources. Both the federal government and the wisest leaders in the oil industry are striving to find some way to check the prevailing extravagance. Chairman Work of the Department of the Interior has suggested the creation of a committee of nine to study legislative action, and both the American Bar Association and the oil industry have appointed their respective members. The Oil Conservation Board of the federal government now will name three representatives.

Note, if you please, that this call by the government is for the purpose of studying "legislative action." We have long been of the opinion that only by legislative action can the present orgy of greed and wastefulness be stopped. Appeals to the good business sense and to the patriotic feelings of the oil getters seem alike to have fallen upon deaf ears. There is no indication of a willingness among the personnel of the oil industry at large to get together for the purpose of controlled drilling. It is time for the law to step in, and it should do so without any over-nice sense of the liberty of the individual.

TERMINOLOGICAL PERVERSITIES

READERS frequently urge us to make a searching scientific investigation of the art of "dowsing," or locating underground water, oil, et cetera, by means of a forked branch of a tree held in front of the body of an allegedly supernormal person.

The SCIENTIFIC AMERICAN will not attempt to investigate dowsing, because in the present stage of the development of science there is not enough knowledge of fundamentals to make it seem likely that an investigation could be pushed to success—and by success we mean, not merely the empiric demonstration that dowsing is effectual (if it really is), but the discovery of the underlying principle, the "why" of it. Sir William Barrett, author of "The Divining Rod," devoted years to the same problem but did not settle it.

In the meantime we are content to let alone in their belief those who have confidence that water supplies can be located by dowsers. We point out, however, that the frequent explanation of the causes of the phenomena, in terms of various "waves," "emanations," "etheric forces" and "vibrations," does not settle the matter. Some seem to think that scientific catch phrases of this sort constitute explanations. Used as they are in such cases as this, just as in the famous "electronic" reactions of Abrams they are nothing but terminological perversities—just words.

How Do the Life Processes Work?

By Means of the New Micro-manipulator Scientists are Trying to Pry Into the Secrets of Protoplasm, the Living Substance—An Example of the Inestimable Value of Research

By WILLIAM SEIFRIZ, Ph.D.
Professor of Botany, University of Pennsylvania

WHERE life exists there is protoplasm. All living things, from the simplest one-celled organisms to man himself, are made up of this extraordinary living substance.

In protoplasm take place those peculiar reactions which distinguish the living from the non-living. What we are and what we do are determined by the physical and chemical constitution of the protoplasm of which we are made. Superficially, protoplasm everywhere looks very much the same, a soft, translucent, jelly-like substance, closely resembling the white of an egg, with no very striking differences in appearance whether seen in the petal of a flower or the brain of a human being.

THAT profound although hidden differences do occur in this substratum of life is self evident. The fact that a frog's egg grows into a frog and an acorn into an oak is due to the particular character of the protoplasm of which the mother cells are made. Why one cell, in a leaf, devotes its entire life to the manufacture of food, and another cell near by, in the stem, has solely to do with the transportation of this food, and still another cell, down in the root, concerns itself with the absorption of water and salts from the soil, is determined primarily by the specific nature of the protoplasm of these cells. Environment plays its part, but a minor one. The problem of metabolism, growth, reproduction, heredity, behavior, disease—in short, the problems of life—are the problems of the physical-chemistry of protoplasm.

The study of living matter presents numerous difficulties. One of these is keeping the substance alive and normal. Once protoplasm is put into a test-tube and chemicals added, once physical instruments are applied to a living cell, the normal activities of life are interfered with and we are no longer observing protoplasm as it exists in the natural state. This will always be true. Herein lies one of the advantages of astronomy; the investigator cannot touch the object which he is observing! But, while the student of living matter is greatly handicapped by its extreme sensitiveness, much has, nevertheless, been accomplished in obtaining a precise knowledge of the physics and chemistry of protoplasm.

The study of the anatomy of cells, and of the physical properties of the living substance which fills them, necessitates the use of lenses of high magnification and of instruments of extreme delicacy. Among such instruments is the micro-manipulator which has, in recent years, contributed much to our knowledge of protoplasm. This apparatus consists of one or more sliding supports to which are clamped fine glass needles, or a micro-pipette, the former for dissection work and the latter for the injection or extraction of substances. The results obtained through the application of micro-manipulative methods to physiological and anatomical problems have been great enough to warrant giving the new technique a name (by Péterfi). "Micrurgy" (*micros*—small, *ergon*—work) is the science of micro-dissection and injection.

The parent instrument for micrurgical operations was the Barber pipette holder, (Figure 6) designed for the isolation of single bacteria. By means of a very fine pipette, held and controlled by the instrument, which, with the aid of three screws, permits moving the pipette in all directions, it is possible to withdraw a single bacterium measuring little more than one micron or one twenty-five-thousandth of an inch. The bacterium thus isolated from a mass of millions is then ejected into a fresh droplet of nutrient medium where it forms a pure culture of its own particular species.

Barber saw in his instrument other possibilities. The pipette was used for injecting substances into cells, and replaced by a needle for the dissection of living microscopic organisms.

THE wide applicability of the earliest replicas of the Barber instrument was soon appreciated, and it came to be used in a variety of biological and medical investigations. The apparatus shown in Figure 1 is one of the earliest replicas of the Barber apparatus. This instrument is now in the pharmacological laboratories of the University of Pennsylvania.

Kite saw in the Barber instrument, as did its inventor, the possibility of converting it into a manipulator for micro-dissection work if needles instead of pipettes were used. This modified form of the original Barber instrument is shown in Figure 2. Under the microscope objective there rests on the microscope platform a glass moist-chamber, on the lower side of the cover of which hangs a water drop in which is suspended the material to be dissected, such as the egg of a star-fish, a blood corpuscle, the mother-cell of pollen grains, the growing tissue of chick embryos, bread-mould, or what not. Projecting into the open ends of the moist chamber are the bent tips of glass dissecting needles. These can be clearly seen in Figure 2 (together with the tip of the core of an electro-magnet).

Dissection then proceeds in precisely the same way as would the dissection

Wide World

THE AUTHOR

FIGURE 1: *Although Dr. Seifriz is a botanist, the research he is performing underlies the whole science of biology, including medicine*

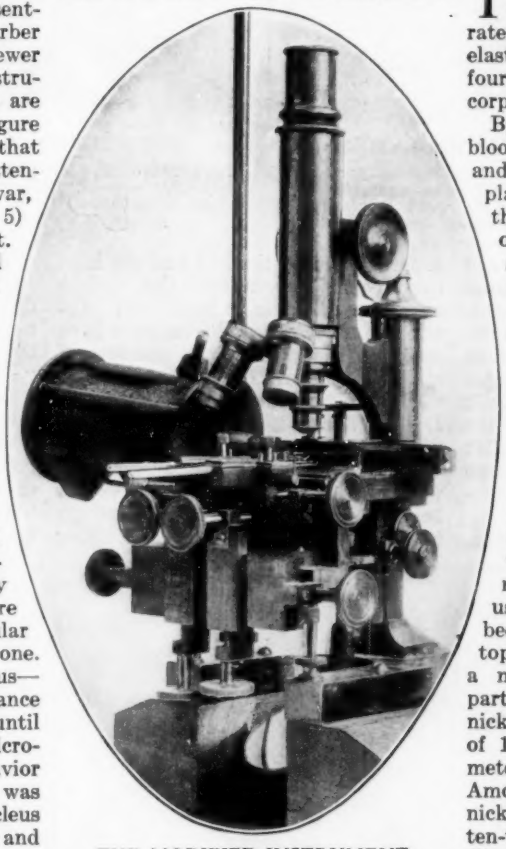
of a human body, only on a much smaller scale. The material to be worked upon is seldom more than six thousandths of an inch in diameter, and often, as in the case of the human red blood cell, only about three ten-thousandths of an inch—much too small to be seen with the naked eye. Laid side by side it would require over one million, five hundred thousand human corpuscles to cover the surface of the average small finger nail.

The original Barber instrument has served as a pattern for two similar models, with a third design representing a radical departure from the Barber type. The oldest of these three newer models is the Chambers'-Leitz instrument (Figure 3). The other two are the Péterfi-Zeiss manipulator (Figure 4), designed in Germany when that nation was able again to turn her attention to pure research after the war, and the Taylor instrument (Figure 5) coming from our western coast. Each apparatus has its own special advantages, but all are planned to accomplish the same end.

As ingenious as are the instruments themselves, it is the things which can be accomplished with them which make one wonder how far science will go in the unearthing of the most hidden secrets of life. The function of hitherto little-understood parts of minute animalcules has been determined by micrurgical methods. In the protozoan Euplotes, a one-celled animal barely visible to the naked eye, there are two nuclei, a very small globular one, and a large worm-shaped one. The function of the small nucleus—whether or not it is of vital importance to the organism—was unknown until it was neatly extracted with a micropipette (by Taylor) and the behavior of the animal, minus its nucleus, was studied. Without the micro-nucleus the organism lives for several days and dies. That the operation is not the cause of death was shown by ingeniously replacing the extracted micronucleus. The patients thus treated formed thriving colonies, growing and multiplying rapidly. The above instance is but one in many where micrurgy has added to our knowledge of the anatomy and physiology of protozoa.

IT is chiefly with the physical properties of protoplasm that micrurgy has had to do, such as viscosity, elasticity, and miscibility, the presence or absence of a surface membrane, and protoplasmic structure.

Especially interesting have been the determinations of pronounced differences in consistency existing in different regions of a cell, notably at certain stages of its development. One of the great problems in cytology and cell physiology is the study of the mechanics of cell division, including the remarkable migration of the chromosomes (the hereditary carrying structures) to the two halves of the newly formed daughter cells. Micrurgical studies have revealed striking regional differences in the consistency of the protoplasm of a dividing cell, a knowledge of which leads to a better understanding of the mechanism of mitosis (cell division). Marked differences in consistency also exist in cells at various stages of development,



THE MODIFIED INSTRUMENT

FIGURE 2: *The double Barber-Kite microdissection instrument. Here it is equipped with an electro-magnet for attracting minute nickel particles which have been inserted in the living cell in the glass moist-chamber. The two fine glass needle points and the small tip of the magnet core may be seen*

and at different rates of protoplasmic movement. Changes in the viscosity of protoplasm are intimately associated with physiological activity.

The most delicate of the determinations of protoplasmic consistency have been those on the living chromosomes. These minute structures, which play so important a part in life by carrying from parents to off-spring those characteristics which distinguish organisms, have actually been isolated (by Chambers and Sands) in the living state and their consistency determined. All studies on the viscosity of protoplasm clearly indicate that the living substance is usually of high consistency, then, resembling fresh egg albumin, though it is frequently more thin.

Equally instructive have been the experimental findings on protoplasmic elasticity. The living substance is highly elastic. There is no better way to observe this than to stretch protoplasm between micro-needles. Convenient material for this is the large blood corpuscle of the "hellbender" (Cryptobranchus).

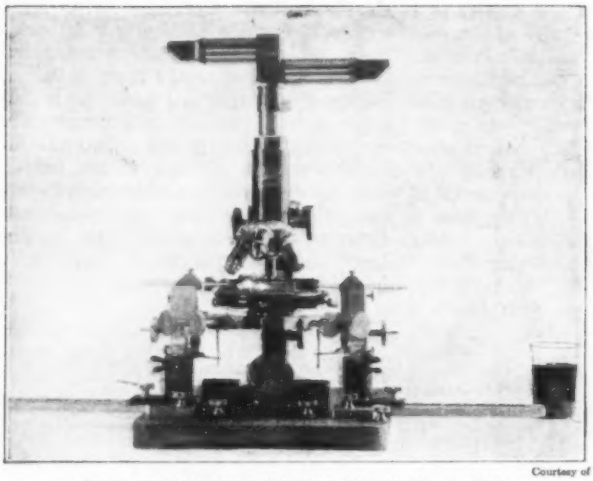
THE glass needles are inserted into the erythrocyte and then separated, stretching the blood cell to its elastic limit (Figure 8) which is some four times the size of the original corpuscle.

By carefully tearing open the red blood cell the nucleus may be liberated and similarly stretched. The nucleoplasm of these amphibian erythrocytes is the most highly elastic of any protoplasm observed. A six ten-thousandths of an inch nucleus may be stretched to 14 thousandths of an inch, and on release of the needles the nuclear substance quickly retracts to nearly its original size.

When protoplasm dies it loses its elasticity. If a dead cell is torn it will not stretch but tears like soft butter.

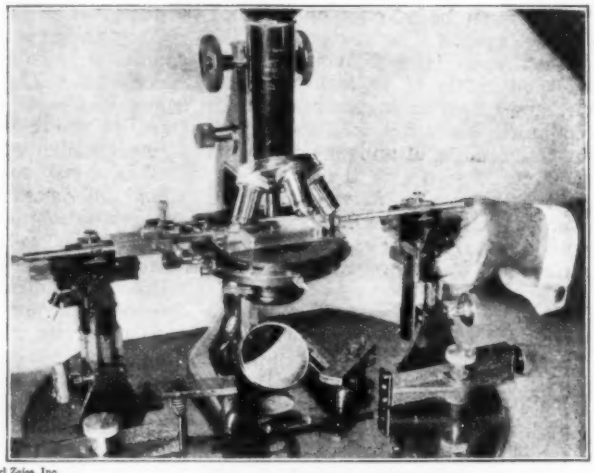
Attempts to measure the degree of elasticity of protoplasm have also progressed along somewhat different lines of experimentation, although involving the use of micrurgical methods. It has been possible to insert into living protoplasm (the eggs of "sand-dollars") a minute magnetic particle. The particles are obtained by screening nickle powder through copper gauze of 10,000 meshes to a square centimeter, or 64,520 to a square inch. Among these screenings may be found nickle particles measuring but four ten-thousandths of an inch in diameter. These are picked up on the tip of a gelatin-coated needle, inserted into the living cell, dislodged by a second needle, and thus left suspended in the protoplasm. Then the specially constructed pole of an electro-magnet (Figure 2) is brought near the cell and the current turned on. The nickel particle is attracted by the magnet and consequently moves a definite distance in the protoplasm of the tiny egg. The displacement is accurately measured by an ocular micrometer in the microscope. The electric current is then turned off and the particle returns to its original position in the cell, due to the elasticity of the living substance.

Micro-dissection studies may be carried out on the human corpuscle. The dissection of the human erythrocyte represents the ultimate in



THE CHAMBERS MICRO-MANIPULATOR

FIGURE 3: *This type of instrument differs somewhat from the other models, having heavy steel springs. The micro-manipulator is simply an attachment for the microscope, equipped with miniature tools controlled by mechanically reduced motions*



Courtesy of Carl Zeiss, Inc.

THE PÉTERFI—ZEISS MICRO-MANIPULATOR

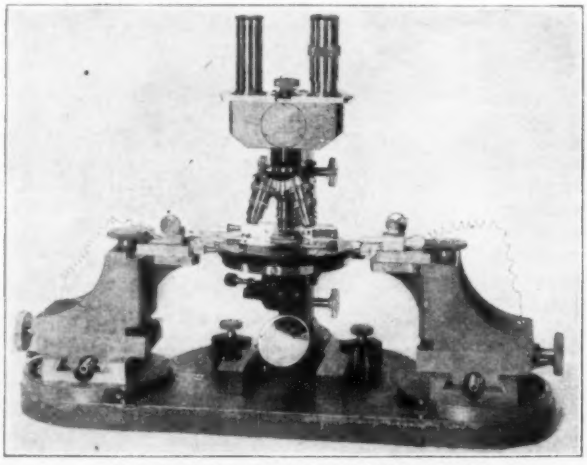
FIGURE 4: *The larger screws are for coarse and the smaller ones for fine movements of the needles. Clamped in the right pillar is a single needle (only the tip is of glass) and in the left is a micro-forceps. Other micro-tools of special design may be used*

micrurgical technique. The blood cell measures but eight twenty-five-thousandths of an inch in diameter, therefore the needles cannot be more than one twenty-five-thousandth of an inch at the tip. The limit of microscopic visibility is but one tenth of this. It has been possible to tear open the human red corpuscle and to establish the presence of a delicate membrane enclosing the contents of hæmoglobin.

The unicellular organism amœba, a tiny droplet of "naked" protoplasm generally regarded as the simplest and lowest form of animal life, is convenient and interesting material for micrurgical study. This little mass of living substance shows the same reactions to torture as do larger organisms.

WHETHER we call it pain, or nervous response, or by the technical term "tropism," the simple fact remains than an amœba will move away, as rapidly as it can, from a disturbance which is causing it "discomfort." Particularly interesting is the ability of this tiny animal to cut off that part of its body which is being irritated by the micro-needle, and, leaving this bit of its own self behind, hurriedly depart for other regions.

Now, of what value are micrurgical findings to human welfare? There is no question which annoys the worker in pure theoretical science more than "Of what use are your investigations?" Just as if the knowledge gained were not alone sufficient justification for the work done! Did Franklin, when he performed his experiment with the key and the kite, first consider whether the results would be of value to mankind? Yet what tremendous additions have been made to the welfare and comfort of man as a result of the first purely theoretical research on electricity! Did Spallanzani, in his studies, done with feverish energy, on queer tiny wriggling specks (bacteria), consider whether his findings would be of benefit to humanity? It was enough to know that these specks are living things, that they do not arise spontaneously but have parents like other living things. Let people call him a queer old fellow, just as they have called every great pioneer investigator, he was happy in his search for truth! And today, for what have we to thank these eccentric experimenters on bacteria—Spallanzani, Pasteur, and the rest? The greater part of medical science, of aseptic surgery, and of sanitary engineering which have added so much to human welfare, is the direct outcome of the work of these men who would persist in studying tiny wriggling specks.



THE TAYLOR MICRO-MANIPULATOR

FIGURE 5: *The chief feature of this instrument is its solidity. It is here equipped with micro-electrodes for measuring electrical potential of living cells. Photograph loaned by Prof. C. V. Taylor*

It is the intense struggle for truth, when sincerely pursued, that raises science to so high a plane. The man who, in the face of opposition and criticism, is determined to know, even though in knowing he may disprove his own pet theories and secure beliefs, is a man of the greatest courage and honor. Science cannot claim for itself a superhuman idealism. But what pettiness there is, is soon obliterated by the work of the unselfish researchers whose contributions, big and small, stand for all time as a monument to the glory of science.

THE investigator in theoretical science has a near brother in the manufacturing world, whose experiments are undertaken with a definite practical purpose in view. All work now done in the laboratories of electrical, pharmaceutical, petroleum, and similar commercial houses is taken up because there is a practical problem to solve. But the distinction between pure and practical science becomes narrower and narrower. Much of interest to the theorist now comes from commercial laboratories, due to the gradual realization on the part of manufacturers of the value of pure science.

The possible benefit of micrurgical studies to mankind has in the main to be predicted, since the science is so young and of so theoretical a nature, and also because the medical sciences have only just begun to appreciate

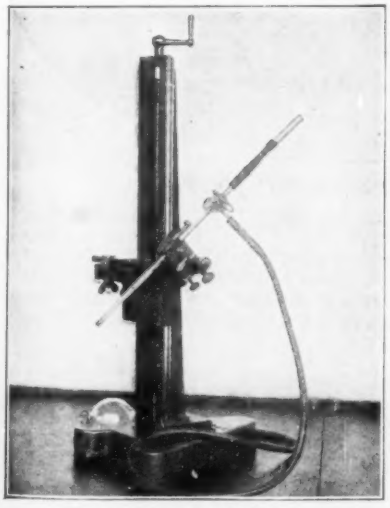
the importance of the experimental findings of cell biology. The application of these findings to medical practice is still less advanced. However, enough has been done clearly to forsee that future medicine will to a great extent be the physical-chemistry of protoplasm.

Let us take just one physical property of protoplasm which has been studied by micrurgical methods, namely, elasticity, and see what possible bearing a knowledge of the presence of this property of living matter has on physiology and medicine.

THE presence of elasticity in protoplasm indicates that living matter must possess a structure which will account for this property. Seen through the microscope, protoplasm is an emulsion; but emulsions cannot be stretched. The visible emulsion can, therefore, have nothing to do with the elastic quality of protoplasm. Protein jellies, on the other hand, are highly elastic. Protoplasm contains proteins. These, then, are the seat of the elastic properties of protoplasm.

Milk is a similar case. As seen through the microscope milk is an emulsion, but when milk coagulates, the emulsion of butter fat plays no part in the process. It is the microscopically invisible casein (a protein) in milk which coagulates.

The elasticity of protoplasm is often extraordinarily high. This is also true of jellies, but not of dilute organic solutions. It appears, therefore, that

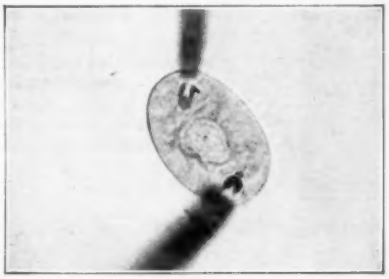


AN EARLY MODEL

FIGURE 6: *The single type of Barber pipette holder, now used at the University of Pennsylvania for extracting minute quantities of fluid from frogs*

protoplasm is a jelly and not a thin watery substance. We arrive at the conclusion that while protoplasm is a very complex heterogeneous system, it is, so far as elasticity as an indicator goes, primarily a protein jelly, and it is in such a system that we must seek for an explanation of the phenomena of life.

Equally instructive are the elastic properties of the surface layer of the living substance. Much has been written about the membrane on the surface of protoplasm, for here is situated the mechanism which determines, in part, what substances may enter the cell. The effect of anesthetics and of poisons, the problems of plant nutrition, of digestion, and of infection, are all questions which involve an understanding of the behavior of the surface layer of protoplasm. It has been postulated that the protoplasmic membrane is comparable to a precipitation membrane, that is, a coagulum. This cannot be, because the protoplasmic



IMPALED

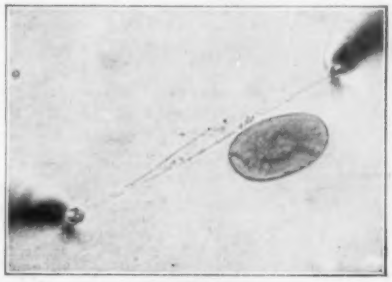
FIGURE 7: *Two tiny micro-needles (out of focus) are stuck into a red blood cell or corpuscle, preparatory to its dissection*

membrane is highly elastic. It can be stretched like any mass of protoplasm, and coagula are not capable of great stretching. It has also been postulated that the protoplasmic membrane is an emulsion, but this also cannot be, since emulsions are not elastic.

A knowledge of the elastic qualities of protoplasm likewise teaches us something of the nature of the red blood cell. A corpuscle which is wholly lacking in elasticity is most certainly a sick blood cell, for a corpuscle, the membrane of which has lost its elastic property, is in a leaky condition and will lose much of the hæmoglobin it contains.

This brief reference to the possible practical value of a knowledge of the elastic properties of protoplasm is but a suggestion of the far-reaching influence which physical biology, in particular micrurgy, will undoubtedly have on medical science. Especially promising are the results obtained from the micro-injection of salts, dyes, et cetera, into the living cells. The different effects of sodium and calcium salts when injected into the cell in minute quantities (by Chambers and Rezinkoff) is of importance since it is these two elements which are present in all physiologically "balanced" solutions (blood, sea-water, milk), and which, therefore, play so important a part in the life history of every cell.

Potassium, much like sodium in its behavior on living systems, is of great significance in biological and medical problems. This element exists in



STRETCHED

FIGURE 8: *A blood corpuscle from an amphibian, stretched to nearly its elastic limit. An untouched cell lies near by*

excess in cancerous tissue. Its amount is a function of the virulence of experimental cancer (in rats). To know, by means of micro-injection, the effect of potassium on the protoplasm of single cells, will be of inestimable value in the study of cancer.

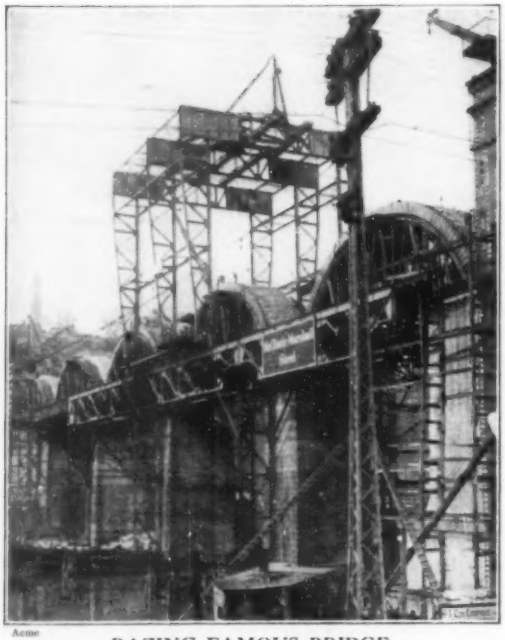
The idea that life and electricity are intimately associated has long been held. The evidence in support of this contention has not been as great as one would anticipate. Micrurgy is now adding experimental proof. With the aid of very delicate micro-electrodes (Figure 5), it has been possible to determine (by Taylor) the potential existing between the interior and the exterior of a single cell. (The voltage is of the order of 0.002 volts.)

IT is evident, therefore, that protoplasmic particles possess an electric charge on their surface just as do suspended colloidal particles of gold or oil, and as do bacteria and blood cells in suspension. The question of the sign and magnitude of surface charge on cells and cell inclusions is intimately connected with the problems of the coagulation of blood, the agglutination and the virulence of bacteria (which are fundamental phases of the study of the cure of germ disease) and the coagulation and death of protoplasm wherever found.

Studies on the physical properties of protoplasm will lead to a better understanding of the nature of living matter and of the mechanism of physiological processes. Only through such studies can we hope to arrive at a clear physical-chemical interpretation of the normal and the pathological or abnormal behavior of protoplasm and, therefore, arrive at a means of alleviating disease.

The Austrian cell-physiologist, Weber, has expressed the whole situation in a concise statement: "The problems of life are the problems of protoplasm."

From the Scrap-book of Science—



Acme

RAZING FAMOUS BRIDGE

High Bridge, which connects the island of Manhattan with the mainland, was famed for its architectural beauty. A single span, permitting passage of larger vessels, will soon replace the several arches of the famous original structure

International Newsreel

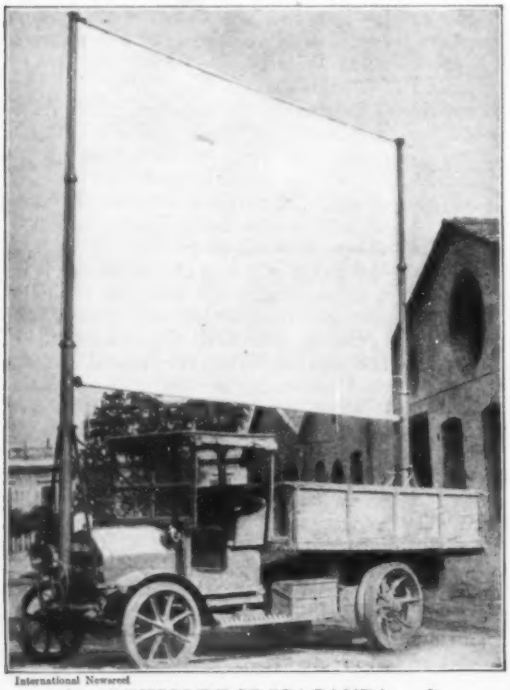
STEAM SHOVEL UNCOVERS FOSSILS

At Carpenteria, California, a steam shovel digging in an asphalt pit has revealed fossils of Pleistocene age. Especially have numerous plant fossils been found. Not far away, at Rancho La Brea near Los Angeles, are the La Brea asphalt pits made famous by the discovery some years ago of large numbers of Pleistocene (ice-age) fossil mammals which had become mired in the asphalt

International Newsreel

STEEL HOUSE "BUTTONS" TOGETHER

Under the auspices of the American Institute of Steel Construction, New York City, a simple type of steel house frame was recently erected in three hours. Standard sized bolts were used to "button" together the steel sills, studs, plates and rafters. The purpose is to provide a simple, standardized six-room residence within the means of the average income, by doing away with expensive labor



International Newsreel

▲ MUSSOLINI PROPAGANDA ➤

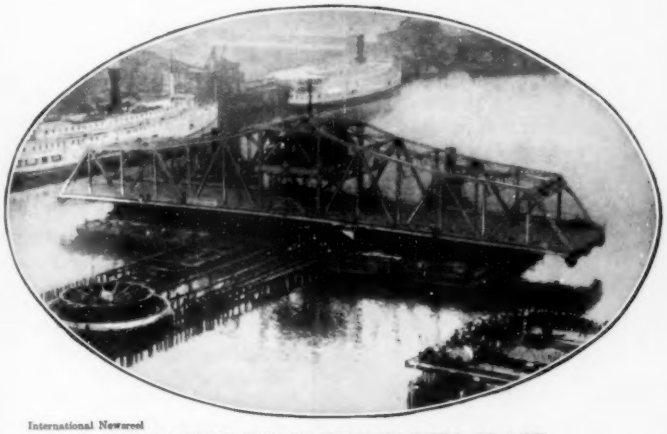
The Italian Government sends out motor trucks (above) equipped to spread stereopticon propaganda at night among crowds (at right) of villagers in the remotest districts of Italy. Anti-government propaganda is, of course, suppressed

Camera Shots of Scientific Events

Wide World

MORE INDIAN PICTOGRAPHS DISCOVERED

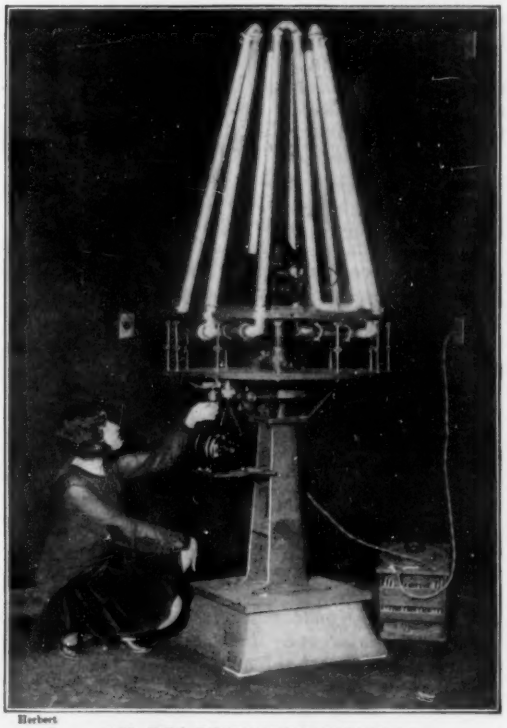
Rocks near Tucson, Arizona, bear ancient Indian "picture-writing." About once a month some traveler in the west finds new pictographs, and then the newspapers spread sensational accounts of prehistoric races, "domesticated dinosaurs," et cetera. But Indian pictographs are not rare. Hundreds are known to scientists



International Newsreel

FLOATING SWING-BRIDGE INTO PLACE

At Providence, Rhode Island, the new Fort Point swing-bridge span was recently floated into place on four large barges. When accurately spotted over the central pivot, the bridge was gradually lowered into its position by allowing water to enter the barges



Herbert

AIR BEACON MORE VISIBLE

A new neon lamp of high power furnishes red light of penetrative wavelength to bore through thick atmosphere and fog. Although exaggerated statements have appeared in newspapers, red light is the most penetrative of the light rays. As an illustration, notice how the red rays from the sun penetrate the atmosphere at sunset

P and A

EXPERT EMASCULATES BOMBS

Perlin L. Charter of Boston, an expert on explosives, is chosen to "kill" all unexploded bombs discovered by the police of that city. Here he is in his laboratory, surrounded by the materials of his unique and dangerous vocation, trying to decide what to do with a T.N.T. bomb

Marconi Smiles on America

The Inventor of Wireless Comes Across the Sea to Marvel at Radio and to See His Dreams of 1890 Surpassed

By ORRIN E. DUNLAP, Jr.

WHEN Guglielmo Marconi was introduced recently at a meeting of the Institute of Radio Engineers, Dr. Michael I. Pupin said that the capacity audience had gathered despite the heavy downpour of rain, not only to hear what the inventor of wireless had to say, but to see his boyish smile. It was on the October afternoon, a few hours before his appearance at the Institute, that I found Senatore Marconi in his suite at the Ritz Carlton, wondering like a boy what the evening had in store for him.

We sat for half an hour talking about radio's future. Marconi had the lecture he was to deliver that night before the Radio Institute on his mind.

"I wonder," he said, "if there will be many there. It is such a rainy day. I have worked hard on this paper and have tried to make it very good."

Then he smiled as he said, "The tickets are free, anyone can come, so I suppose that a few will be there."

It was evident that the presentation of his paper was as much on his mind as a poem which a lad in school might be scheduled to recite. The ovation he received that night when he stepped out on the platform, and again at the close of his address, made him happy, and the audience saw that smile for which Marconi is famous.

MANY questions are asked about Marconi. How old is he? What sort of a man is he to meet? Does he speak English? Does he really know the science of wireless or did he just stumble upon it and become internationally known through publicity?

Senatore Marconi is 53. He is most human to meet and in talking with him a radio man feels as much at ease as when talking with a good friend. He speaks English with perfect diction. He usually refers to "wireless" rather than "radio." Probably that is because he grew up with "wireless," and now finds it difficult to change the name to "radio," as ethereal communication is known in the United States.

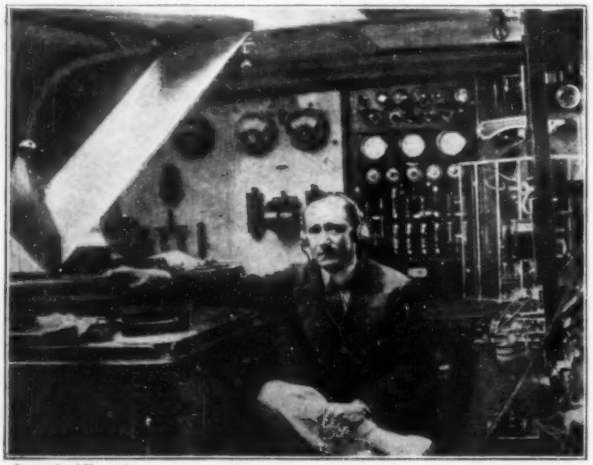
He knows wireless, radio, broadcasting, radiocasting, or anything one might call it, from "A to Z." He answers questions on radio as quick as a flash. He does not have to ponder over the answers. For example, he was asked what fields of radio he considered most fertile for the amateur experimenter and young engineer just out of college. His ready reply was, "Short waves, directive transmission, and television!"

Marconi is a hard, thorough worker. Work is the secret of his success. Not satisfied with the achievement of giving mankind a new communication system, he has been busy striving to improve its efficiency. It is his contention that only the feeble minded stop and abandon their life's interest for the sake of idleness. He explained that the first feeble dots and dashes that he heard come through the ether constituted merely the starting point of a life devoted to perfecting his invention.

When he was here in 1922 he demonstrated his idea of beam transmission with miniature apparatus on the stage of the Engineering Societies Building. He called attention to the fact that radio experimenters were in a rut because they had neglected wavelengths below 100 meters. When he returned to America in 1927 he showed lantern slides of powerful beam stations with which he has girdled the globe since he sailed away on his yacht *Elettra* in 1922. Radiating from London as a center, Marconi pointed to the silver screen, and traced the routes of the beams, which today run across the globe like the ribs of an open umbrella. Those lines on the map showed that he is master of his dreams.

"I may perhaps be forgiven," said Marconi, "if I say that it is with some considerable satisfaction and even pride that I am able to recall the fact that when five years ago I was last here, it was probably the first occasion on which the question of the urgent desirability of the study of short waves for practical radio purposes was publicly proposed and strongly recommended to the attention of experts."

What sort of man is Marconi? He is a distinct gentleman, a genius and a modest, conservative scientist. Well may he be called "wireless wizard" and "master of space." He has always been and always will be the outstanding figure in radio. He has no equal. He is the Edison in his field. It has been said that he inherited his Irish persistence, initiative and alertness from his mother, Anna Jameson, and from his Italian father, power of invention and conception.



International Newsreel

A FLOATING LABORATORY

Marconi in one of the apparatus rooms of his famous yacht, Elettra. *He says a ship is the best place for making comparative observations*

HE is always quick to give credit to others. In the papers he has prepared for scientific bodies, footnotes can always be found giving credit to his assistants or to other experimenters who have made useful discoveries in the realm of radio. He never makes an announcement to the public until he is absolutely certain of its truth. So when Marconi says, "I believe television is finally emerging from the laboratory," one may look forward to bigger and better radio.

"When I first came to America 27 years ago to receive the first transatlantic wireless signal, the Americans gave me much encouragement and invaluable support," said the inventor. "Radio would not be what it is today except for the punch put into it as soon as it was taken up by the United States."

He added that the development of broadcasting as he finds it in America today has surpassed his greatest dreams, which spurred him on as a youth in the days of the early 90's.

In talking with Mr. Marconi one quickly realizes that the future is

bright for all branches of radio communication—in broadcasting, marine communication, television, directive beam transmission, short waves, aircraft communication, radio beacons and compasses, and last but not least, in amateur wireless. But the inventor stresses the possibilities and the importance of short waves and directive transmission. These two divisions of the science seem to be closest to his heart and mind today. He believes that many secrets of photo-radio, facsimile transmission, high-speed communication and television are still hidden in the wavelengths below 80 meters and in the narrow beams of energy that the short waves are made to carry in much the same fashion that a searchlight casts a beam of light.

"I am profoundly impressed with the enthusiasm of the people in the United States for radio," said Mr. Marconi. "The progress made here is remarkable. There are three things that have attracted my attention in New York: First, the enthusiasm of the public for broadcasting; secondly, the practical purposes to which wireless is utilized and, third, I am surprised at the general knowledge of wireless among the younger generation. The elders are dragged into wireless for entertainment, but the youths are in it because they find it fascinating, and that is most fortunate. Youth has the punch and the go. That is what will send radio ahead. Wireless offers many possibilities for amateur experimenters. We have all been helped by the amateurs. It is a great asset to have such a vast number of amateur experimenters interested in the science."

"DO you believe that television will enter the homes on as large a scale as concerts at the present time?" he was asked.

"Yes; television will be seen in homes throughout the land, but I do not know how soon."

"In your opinion will the present broadcast band of 550 to 200 meters ever be changed to short waves, thus necessitating the scrapping of present equipment?"

"I can see a big field for short waves," said the inventor, "but they will play their most important role in international exchange of programs; that is, for long-distance broadcasting. Short waves have the ability to span seas and continents with comparatively small power outputs. However, I believe the wave band now used for broadcasting entertainment is well adapted for that use, and I can see no benefit to be gained for the broadcasting stations to operate on channels below 100 meters unless they desire to be heard in foreign countries.

"The same applies to radio and airplanes," said Mr. Marconi. "I would not care to say that short waves are better suited for aircraft communication than the longer waves, say, in the neighborhood of 600 meters. What an aviator needs most of radio is to call and find his position in fogs or when lost. In such cases a good strong signal from a near-by transmitter is more to be desired. For example, an airplane lost near Hawaii would want its signals heard in the immediate vicinity so that the position could be determined or assistance dispatched. What good would be accomplished if short wave signals were used that skipped over the Hawaii area but reached New York?"

"What are the possibilities in the five-meter band?" "I do not know," was the reply. "I can only say that I have covered 100 miles with six-meter waves, and with a ten-meter

Wide World

MARCONI'S SMILE

The discoverer of wireless, as he waved to friends from New York's City Hall

wave I have sent a message from England to Australia."

"Do you think the vacuum tube has reached a stage of development where perfection has been attained?"

"The present vacuum tubes are very good, but they will certainly be improved. The alternating-current tubes in the latest American sets are very practical, but they do not represent a big scientific advance in radio. Their utility is found in the fact that they make radio more convenient to install and operate, because batteries are dispensed with, and that seems to be what the public wants. Few radio set owners care to be bothered with the process battery charging.

"Long-distance radio communication in the future will be handled by short waves," predicted Mr. Marconi. "Until a few years ago short waves were neglected. Only recently have we discovered that these waves possess most valuable and unsuspected qualities in regard to world-wide transmission and that they are capable of results unobtainable with long waves. Short-wave beam transmission has taught us many lessons. We have noticed in working long distances by means of short waves that, particularly when receiving reflectors are employed, static has been generally conspicuous by its absence, but when noticeable, the signal strength has mostly been well above the disturbance strength level of static. I feel confident that our old enemy, static, no longer exists as a serious hinderer to the working of high-speed radio as carried out by the beam system.

"IT is interesting to note that we have discovered that the position and altitude of the sun have an effect as to which route the waves follow, and that during the morning in England the waves travel to Australia in a westerly direction across the Atlantic Ocean, following the great circle, along the longest route, which is approximately 14,000 miles; whereas during the afternoon and part of the night the waves travel best in an easterly direction over Europe and Asia, following the shortest great-circle route, which is about 10,000 miles. In consequence, the transmitting and receiving apparatus is constructed with an aerial system on either side of a central reflector so that it is possible to send to Australia from England in the direction of either the easterly or westerly great circle.

"Fading remains one of the most serious obstacles," continued Senatore Marconi, "although it is worse on channels between 200 and 1000 meters than on short waves."

Referring to the benefit of short waves to the man with a receiving set in his home, he said: "Short waves are beginning to show unhoped for results in improving broadcasting by making it workable over great distances, even during daylight hours. And directive methods will soon be utilized for broadcasting by enabling programs and speeches to be sent over large portions of America and to foreign countries, with much more strength and freedom from interference than is possible now."

A few days after these remarks by Marconi, he sailed for Europe and as the ship left the pier, a prominent radio engineer was heard to say, "Marconi is a wonderful man. He is a man of big thoughts. To him the world is like a baseball resting in the palm of a hand."

A Scientific Ghost Laid

Fully Investigated, the Supposed Element "Nebulium" Turns Out to be Nothing but Common Everyday Air

By HENRY NORRIS RUSSELL, Ph. D.

Chairman of the Department of Astronomy and Director of the Observatory, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

A SHORT paper, published unobtrusively a few weeks ago, has excited unusual interest among astronomers. In a single page it gives the answer to one of Nature's riddles which has baffled the world of science for sixty years—the composition of the gaseous nebulae. This noteworthy discovery—by far the most remarkable of the year now closing—has been made, not by an astronomer, but by a physicist, Dr. Bowen, one of Professor Millikan's associates at the California Institute of Technology, at Pasadena.

WHEN Huggins, 60 years ago, first turned his spectroscope upon the skies, he found that the great nebula in Orion, and many others, gave a spectrum composed of sharp isolated bright lines, which proved that the luminous material was a glowing, rarified gas. Some of the lines were recognized as due to hydrogen, but others, including the two strongest, in the green, could not be matched artificially.

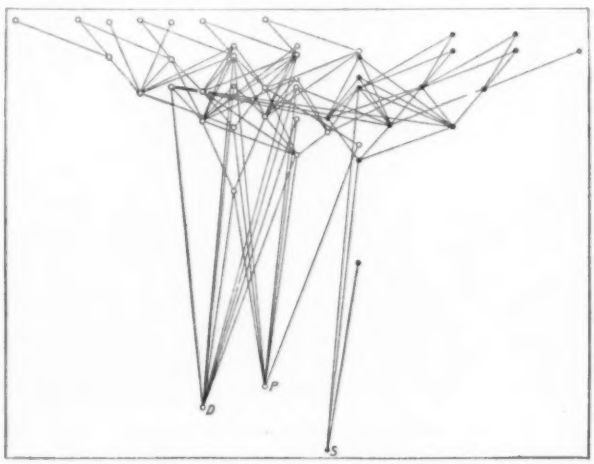
Modern photographic observations have revealed more lines, many of them in the ultra-violet and invisible to the eye, and determined their positions with precision. The most complete list, compiled by Wright in 1918, includes 70 lines. Of these, 14 are due to hydrogen; as many more agree with known lines of neutral and ionized helium; and a few of the fainter ones with strong lines of ionized carbon, nitrogen and oxygen. But nearly half the list, including the strongest lines of all, have never been matched in any terrestrial laboratory.

It has often been suggested that these lines indicated the presence in the nebula of some otherwise unknown element, "nebulium." Until within the last 15 years this suggestion appeared quite reasonable. But since then weighty evidence has appeared against it.

In the first place, the nebular lines do not appear with very different intensities in different nebulæ. Huggins' pair in the green (with wave lengths 5007 and 4959 on the usual scale) evidently belong together, as do a pair in the ultra-violet at 3726, 3729 and one in the red at 6548, 6585; but no two of these pairs show evidence of relation to one another. It would seem, then, that there must be at least three different kinds of nebulium—more, indeed, since some of the ultra-violet lines behave still differently.

In the second place, and still more important, comes the firmly-established conclusion of modern atomic physics that there are no unknown elements left to be discovered, except a few of great atomic weight. All the elements which give known lines in the nebulae have light atoms and are either gaseous at low temperatures or form compounds which are gaseous; and there is no room left, according to our present knowledge, for the existence of any unknown light atoms.

The conclusion is forced upon us, then, that the nebular lines must be due to known elements. Why, then, should careful experiments in the laboratory under the most varied conditions fail to produce a trace of them?



ENERGY STATES, IONIZED OXYGEN ATOM

Taken from an analysis of the spectrum by Fowler, Bowen and the author. Explained in the text

It is not credible that the atoms in the nebulae are stirred up to shine by a more powerful excitation than any that we can equal on earth, for the known nebular lines, though demanding rather high excitation, can all be produced under proper conditions with a potential of less than 100 volts.

But there is another difference between nebular and laboratory conditions which we cannot hope to imitate. The density of the nebular gas must be excessively small. It can easily be proved, for example, that if in the Orion nebula a cubic mile of space contained more than enough gas to make a single cubic inch of ordinary air, the whole mass would be so great as to produce perceptible effects on the motions of the near-by stars; and calculations for other nebulae give similar results.

IN ordinary air any given atom or molecule as it flies about collides with others several thousand million times per second. In the rarified gas of an ordinary vacuum tube such as is used to produce laboratory spectra the number of collisons per second is counted in the millions; but in the nebulae successive collisons probably come at intervals of hours or even days.

Suppose now that the atoms of some kind are perfectly capable of giving out light of some special sort, but that they take time to get ready to do so. If this time is a millionth of a second, or longer, there will be very little chance that the process will happen in an ordinary vacuum tube, for long before it is over the atom is likely to be hit by another and put out of business, so far as the present job is concerned. But in the conditions which prevail in the nebulæ the "latent time" of preparation might extend to a second or even a minute (almost an eternity from the standpoint of atomic events) and the chance of disturbance by collision be very small.

Considerations of this sort have been familiar to many astro-physicists; the present writer, for example, put them on record a year ago. Dr. Bowen has passed from theory to fact by finding out just what this time-consuming atomic process is, and just what atoms are carrying it on.

When an atom gives out light it is unloading energy with which it has previously been charged—whether by absorption of light, by collision with an electron or by various other means. These excited atoms may be loaded

with internal energy in any one of many different but perfectly definite ways, giving a corresponding number of possible "energy states." An excited atom in any given state may spontaneously pass to certain other states in which it is less highly loaded, discharging the surplus energy in the form of light—a spectral line. The number of waves per second in this light is exactly proportional to the amount of energy which is unloaded. This makes it possible, by studying the spectrum, to work out full details of the set of energy states which belong to a given atom, and the rules which tell which "jumps" from one state to another take place of their own accord, though rather complicated, are now well known.

IT has been discovered, too, that an excited atom usually has a short life. If a transition to some "lower" state, by giving out light, is possible, it will happen, on the average, in something like a hundred millionth part of a second. In a vacuum tube, therefore, an atom which has in any way become excited stands a very good chance of unloading by radiation before the next collision. If, while it is still excited, it collides with another atom the store of internal energy is likely to be dissipated, no light will be given out.

The energy states for the lighter atoms have been well worked out in the last few years, and in this work Millikan and Bowen have played a leading part. What the results are like can best be illustrated by a diagram such as the one reproduced in these columns, which shows the energy states for an ionized atom of oxygen. Each energy state is represented by a dot; and the greater the amount of stored energy the higher is the dot upon the diagram. The lines connecting the dots show what spontaneous changes, accompanied by the emission of light, are known to occur. It is a fairly complicated diagram, but the oxygen atom is still more complicated, for the white, open-centered dots represent pairs of states and the black ones sets of four neighboring states too close together to show on this scale.

At first sight it looks like a hopeless tangle; but if we fix our attention on any one dot it is easy to see how an atom in the corresponding state can unload energy by dropping down to one of the lower states, as is shown by the connecting lines. From this state it may drop again to one still lower, and so on; and in the actual atom these successive changes will follow one another at intervals of something like a hundred millionth part of a second.

At whatever point we start on the diagram, and whichever one of the alternative downward routes we follow, we shall find that we reach, after a succession of steps, one of the three lowest points marked S, D and P, and once arrived at any of them we can go no farther. This means that an actual atom, if excited into any one of the higher energy states, will give out, successively, light of different spectral lines, and within much less than a millionth of a second, settle down into any of the three states represented by S, D or P, at the bottom of the figure. What happens after that?

TYPICAL SPECTRUM OF A GASEOUS NEBULA

The vertical lines are prominent bands of light of specific wavelengths. Were the star or other source of light sending out light of all wavelengths as would, for example, a candle, we should obtain what is called a "continuous spectrum," that is, one having no bands of light or darkness, the colors from red to violet blending insensibly into one another. This is the case where the source of light is incandescent. But gases under low pressure emit another kind of spectrum, the "discontinuous" or "bright-line" type such as the above, it being typical of the class discussed by Dr. Russell in this article. The third type of spectra are called "absorption spectra," formed when white light, that is, light containing all wavelengths, passes through a gas. Here the gas absorbs exactly the same series of wavelengths that its own bright-line spectrum would otherwise contain

The S state is the normal state of the atom, in which it has just got rid of all the energy it can, and if it is in this state nothing more will happen (unless indeed it picks up a loose electron, in which case it starts a whole new set of performances which do not concern us here). But the D and P states are more interesting. The atom is still charged with energy, but apparently cannot unload it. It is in what is called a "metastable" state. If an atom in such a state collides with another, the energy is unloaded and goes to increase the speeds with which they fly apart. In the absence of collisions what happens? There is good evidence to show that the rule which forbids the atom to unload by radiation is not quite rigorous. The prohibition, in fact, does not quite prohibit; but it is pretty fair prohibition just the same, being probably something like 99 99/100 percent efficient.

IN an ordinary vacuum tube, therefore, the frequent collisions will unload the atom in the P and D states before they have time to give out light; but in the nebulæ, where there are practically no collisions, the light-giving process will be operative.

These are the considerations which occurred to Dr. Bowen—and an immediate practical test was possible. His careful measures of the extreme ultra-violet spectrum—represented by the long lines dropping to P, D and S in Figure 1—made it possible to figure out what was the difference in level between P and D, and what the number of waves per second and the position of the lines in the spectrum corresponding to this transition would be. The predicted line, a double too close to be separated with the relatively low dispersion used on the nebulae, lies at 7326 in the extreme red; a strong line has been observed at 7325. The change from D to S should give a pair of lines at 3725, 3728, agreeing with the strong observed pair in the ultra-violet as closely as could be anticipated.

Testing other spectra in a similar fashion Bowen finds that a transition between metastable states in ionized nitrogen accounts for the strong pair of lines in the red, while a similar one in doubly ionized oxygen gives the pair in the green, and another transition in the same atom leads to a strong line at 4363 in the violet.

All but two of the strongest unknown lines in the nebulae are thus accounted for at a single blow, and it may be that the others may be explained when other spectra are worked over. The calculations suffice to settle the question, though the nebular lines have never yet been produced on earth. Whether experimenters may succeed in doing so now that they know what to work with, future research may soon reveal.

WE know already what makes the gas in the nebulæ shine—the atoms are loaded up with energy by the absorption of light of extremely short wavelength which comes from excessively hot stars near the nebulae—so that we have now a good idea of the whole process involved.

There are other unknown lines in various astronomical spectra—in a few peculiar stars and in the solar corona—and it is not too much to hope that many, if not all, of these will soon be identified as due to similar "forbidden" transitions in the atoms of rarified gases.

Meanwhile the greatest outstanding problem of astronomical spectroscopy is solved—and solved in an amazingly simple fashion. The unknown lines turn out to be produced by the gases which we take in at every breath. "Nebulium" is no longer unknown: it has vanished, literally, into thin air.

¶ *Is the Mississippi flood problem now "old stuff?" To readers of tabloid newspapers it doubtless is, but* SCIENTIFIC AMERICAN *readers will maintain consistently a thoughtful interest in the Mississippi flood problem until it is finally settled, if it takes a lifetime. Next month we shall publish a thought-provoking discussion of the several phases of this great problem*

Successful Inventors—XIII

Can It Be Sold? That Is the Test, Says an Inventor Who Made His Fortune

By MILTON WRIGHT

"MANY inventors fail to make a commercial success because they do their inventing in a field they know nothing about. A harness maker will think up a bright idea for dentists, or a jeweler will have a flash of inspiration about something he thinks ought to appeal to automotive engineers. If they would make inventions in their own lines they might get somewhere."

So says David M. J. Wall, inventor of many things, the best known of which—the "Bobbie" pipe reamer—has made him independently wealthy.

"Here's another thing to remember. You can make an invention that is good, ingenious and patentable. But if you can not sell it, what use is it?"

"Mr. Wall," we said to him, "your experience as an inventor ought to be valuable. How did you come to be an inventor? How did you make your inventions pay?"

"TO handle tools and machinery has come natural to me from the time I was a boy. My mind seemed to run to making things that were ingenious. My first invention was a bachelor button. We wore suspenders in those days and many men did not have women at home to sew buttons for them. When I got my patent, I wanted to put the article on the market, but my father would not stand for it. He had taken me with him in the cotton and woolen business and I was not going to be an inventor if he could help it. I had to sell the patent, and my father took the 500 dollars I received and put it in the bank.

"There was no future in the cotton and woolen business for me, as far as I could see, and, anyway, I thought I ought to get out into something I would enjoy. My brother and I took 250 dollars and went into the novelty business. The first invention I marketed was a tie clasp—a little piece of round rubber that would hold down the under string of a four-in-hand tie and hold up a pair of drawers. I couldn't make much money by selling the patent. The profit came from selling the patented article. We sold thousands to jobbers and made quite a lot of money in a short time.

"My next invention was a cleaning compound. I called it 'Klenol.' I started to market it myself and I was beginning to sell large quantities when I was taken sick. After nine weeks in bed the doctor ordered me to Denver. I was out of business for more than a year. While I was recovering my health, I made a new invention.

"McKinley was running for president on a high protective tariff program. I designed a little badge. The top of it represented a bag of gold. Suspended from this was an American flag. Hanging from the flag was a little dinner pail. The words 'Sound Money' appeared on the bag and the words 'Protection Fills' on the dinner pail. You never saw anything go like that novelty. They sold everywhere. The Republican National Committee bought immense quantities; and jobbers all over the country loaded up with them. I made 50,000 dollars in three months."

STILL MAKING THINGS

"Some of us just have to keep on working," says David M. J. Wall a life-long inventor whose story is told here

"Have you found it necessary to make money quickly with all your inventions; has each one been a fad which died out after a short time?" we interrupted.

"Not at all," he answered. "Some of them have been selling for years. In 1898 I invented a luggage carrier for bicycles. At that time everybody in the country was riding bicycles. This carrier was a net with a couple of hooks that could be hung over the handle bars. It was neat, compact and convenient and would support packages weighing as much as 50 pounds. In two years we sold about 25,000 gross. Later I sold the patent. The bicycle industry declined, but I think they are still making luggage carriers, selling them principally abroad."

"What has been your most successful invention?"

"The 'Bobbie' Pipe Reamer. Sitting in my office one day with a pipe, I took out my pen knife to cut away the hard cake in my pipe bowl. As I started to cut I realized how much in danger I was of splitting my pipe. It occurred to me it would be a good thing to make a little metal device with toothed edges to scrape out the bowl. I got a piece of sheet copper and made one. It worked fairly well but the teeth were too sharp. The next day I made another one, using a piece of galvanized sheet iron. That was better. The next day I made one of sheet steel. It was just what I wanted. It took the surplus cake out, leaving just enough of the cake in to keep the pipe sweet.

"REALIZING I had something that pipe smokers would want, I went to a patent attorney and had him file a patent application. Naturally, I discussed my new invention with my friends.

"'That certainly ought to go big in the ten-cent stores,' they told me. As I reasoned it, however, there would be far more of them sold at 25 cents than there would at 10 cents. In the first place, pipe smokers do not go shopping in the 10 cent stores. In the second place they would think more of it if it were a quarter than if it were a dime. However, I determined to make a test.

"I had a number of display cards made. The wording on each was identical except that on one card I said 10 cents and on the other 25 cents. I put six reamers on each card and then went out on Broadway. At the first newsstand I came to I handed a man one of the 10 cent cards and said, 'Here's a new article. Put it where it can be seen.' I went up the street until I came to the next stand. Here I gave the man a 25 cent card. I kept on going, leaving a 10 cent card at one stand and a 25 cent card at the next until I had placed the entire dozen. A week later I called back.

The stands with the 10 cent card had sold only a few. All of the 25 cent card stands were sold out.

"There was no question now as to the retail price. I went around to a number of cigar stores, stationery stores and newsstands and got orders for the reamers. With these orders I went to the Metropolitan Tobacco Company and offered to supply them with all the reamers they could sell. They turned their salesmen loose and hundreds of thousands of the reamers were sold. I convinced the United Cigar Stores that the pipe reamer would sell and they sold more hundreds of thousands."

"Could you have made a profit if the retail price had been only 10 cents?"

"YES, I could have made a very handsome profit, but I would not have sold as many."

"How much did you make out of the pipe reamer?"

"I made enough to retire comfortably. I'd rather not say just how much I have made, but it was more than a quarter of a million dollars. After six and a half years I sold out."

"Have you ever had trouble with infringers?" we asked.

"Yes," he replied. "I had one experience. As soon as the reamers began to make a hit, another fellow got out some that looked very much like mine. He mounted them on cards that resembled mine, but he made the price 15 cents. My attorney sued him under the law of unfair competition. We put him out of business in five days."

"Have you ever had an invention that has failed to show you a profit?"

"No. Some of my inventions have not made much, but that is because I have not done anything with them. That was true of the bachelor button. It is also true of a couple of inventions I have now which I have not patented and which I probably will not do anything with because it would take more energy than a man of my years—I am 66 years old now—cares to exert."

"Why, then, do you keep up this workshop?"

"To work in, of course. Just because I have made my pile with a few inventions, I can't fold my hands and do nothing. I like to work; I like to make things. I like to do things differently from the way they have been done before. I should hate to think that a day will come when I have to stop working."

"Have you had much experience with other inventors?"

"Yes; most of them are impractical. You would be surprised at the number of inventors who write to me, asking me to help them. I recall one in particular. He had a little boring apparatus for cleaning out the stem of a pipe. It could be carried in the pocket like a fountain pen. He insisted that it could be sold. I admitted that some of them could, but I knew that he could not sell enough of them to make money.

"I must have had a dozen letters from inventors with pipe reamers. They think that because mine made a lot of money, theirs ought to, too. Even if theirs were better they couldn't pay. By this time my pipe reamer has come to be recognized as a standard article and it would be impossible to replace it, even by something better."

"What, Mr. Wall, would you say is the chief requisite for successful inventing?"

"THAT depends upon what you mean by successful inventing. To be mechanically successful I should say that a man would have to be born an inventor. I have heard lawyers and patent experts argue about the so-called 'inventive faculty.' If by inventive faculty is meant creative ability I believe that it is something you can not acquire.

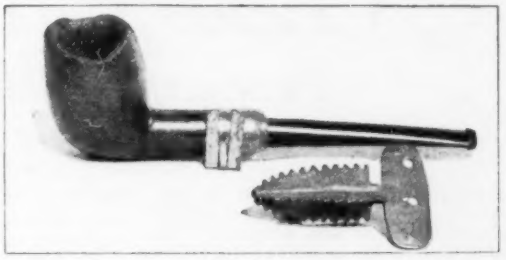
"Born with this inventive faculty, a man should be trained as an engineer or a scientist in order that he may make discoveries or inventions which really advance civilization. In my case, I should have gone with Thomas A. Edison or some other scientist with a fully equipped laboratory. As it is, such inventions as I have made have been rather simple little things. However, they were just the things people wanted.

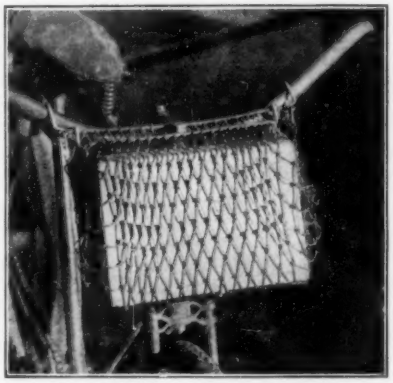
"This brings us to the second kind of success in inventing—commercial success. The first thing is to recognize what people will want—to know what to invent. There usually is a lot more genius in knowing what to invent than there is in actually working out the invention. And this knowledge of what will be popular is a sort of intuition. Much can be learned by long familiarity with notions and novelties, but to be able to predict just which way the public is 'going to jump' is a gift worth a lot of money to any man.

"But even if you hit with uncanny accuracy upon what to invent, even if you work out that brilliant idea with wonderful ingenuity, even if you get the strongest kind of patent protection, the hardest part of your work has just begun. You still have your marketing to do, and this requires good common sense, a knowledge of your field, selling ability, and hard work. After all, the real test of an invention is the answer to the question: Can it be sold?"

SOUVENIRS

We all have them. Wall's are the pipe that had a hard cake in it one day and the hand-made reamer he devised from a piece of sheet brass to clean it out neatly—the invention that has brought him in more than a quarter of a million dollars





INVENTIONS MUST BE TIMELY

Wall's luggage carrier succeeded because it came before the bicycle craze died out

SUCCESSES ARE IMITATED

Prompt action suppressed the infringer who sought to capitalize the "Bobbie's" success

Cricket Champions of China

Passion of the Chinese for Insect Musicians and Fighters Is Age-old and Unceasing

KEEPING animals or birds in captivity may seem to some people infinitely heartless and cruel, but the keeping of crickets in China in order to enjoy their musical efforts and fighting ability cannot be so considered because of the loving care bestowed on these pets. The Chinese have made such a patient study of their insect-musicians and fighters and are so fond of them that their health, comfort, and proper feeding always come first in the thoughts of their keepers.

Cricket fights are not as cruel as cock and quail fights in which the Chinese also indulge, nor are the three combined as cruel as the bull fights of Spain and Latin America.

China, venerable "Wise Man of the East," is shown in this article prepared from material in a monograph by Dr. Berthold Laufer, Curator of Anthropology at Field Museum of Natural History, Chicago, as a sentimental, loving student of the lowly cricket which, in many lands, is merely considered an omen of good fortune.

—*The Editor.*

OF the many insects that are capable of producing sound in various ways, the best known and the most expert musicians are the crickets, who during the latter part of summer and in the autumn fill the air with a continuous concert. They are well known on account of their abundance, their wide distribution, their characteristic chirping, and the habit many of them have of seeking shelter in human habitations.

Of crickets there are three distinct groups—known as mole-crickets, true crickets, and tree-crickets. The first-named are so called because they burrow in the ground like moles; they are pre-eminently burrowers. The mole-crickets feed upon the tender roots of various plants. The true crickets are common everywhere, living in fields, and some species even in our houses. They usually live on plants, but are not strictly vegetarians; sometimes they are predaceous and feed mercilessly upon other insects. The eggs are laid in the autumn, usually in the ground, and are hatched in the following summer. The greater number of the old insects die on the approach of winter; a few, however, survive the cold season. The tree-crickets principally inhabit trees, but they occur also on shrubs, or even on high herbs and tall grass.

Like their near relatives, crickets have biting mouth parts, and, like the grasshoppers and katydids, rather long hind legs which enable them to jump. Although many of them have wings when full grown, they move about mainly by jumping or hopping. When the young cricket emerges from the egg, it strongly resembles the adult, but it lacks wings and wing-covers, which gradually appear as the insect grows older and larger. The final development of wings and wing-covers furnishes the means whereby the male cricket can produce his familiar chirping sound. It is only the adult male that sings; the young and the females cannot chirp.

All photos courtesy Field Museum of Natural History

BOY CRICKET CATCHERS

Twelfth century Chinese painting showing boys playing with crickets. One is shown with trap and jar

On examining the base of the fore wings or wing-covers of the male cricket, it will be noticed that the veins at the base are fewer, thicker, and more irregular than those on the hind or lower wings. On the underside of some of these thick veins will also be seen fine, transverse ridges like those on a file. The wing-covers of the female have uniform, parallel veins, without a trace of ridges. The male cricket produces his chirping sound by raising his wing-covers above his body and then rubbing their bases together, so that the file-like veins of the under surface of the one wing-cover scrape the upper surface of the lower.

The sound made by crickets is, of course, not a true song, but a mechanical production, as are all of the sounds produced by insects. The object of the chirping or stridulating is somewhat conjectural. It may be a love-song, mating-call, or an expression of some other emotion. The fact that the crickets are able to sing only when they are full grown and capable of mating would seem to suggest that their chirping is a love-song.

This commonly held view, however, is contested by Frank E. Lutz in a recent article on "Insect Sounds" published in *Natural History*. Dr. Lutz starts from the opinion that not everything in nature has a practical or utilitarian purpose and that many striking characters and characteristics of animals and plants are of no use to their possessors or to any other creature; they seem to him to be much like the figures in a kaleidoscope, definite and doubtless due to some internal mechanism, but not serving any special purpose.

THE Chinese, perhaps, have made a not uninteresting contribution to this problem. Of the many species of crickets used by them, the females are kept only of one—the black tree-cricket, called by them *kin chung* ("Golden Bell," with reference to its sounds), as they assert that this is the only kind of cricket that requires the presence of the female to sing. The females of all other species are not kept by the Chinese. As soon as the insects are old enough for their sex to be determined, the females are fed to birds or sold to bird-fanciers.

But whether captive insects are instructive examples for the study of the origin and motives of their chirps is another question. Our canaries and other birds in confinement likewise sing without females. Whatever the biological origin of insect sound may be it seems reasonable to infer that the endless repetition of such sounds has the tendency to develop into a purely mechanical practice which the insect in-

dulges as a pastime for its own diversion.

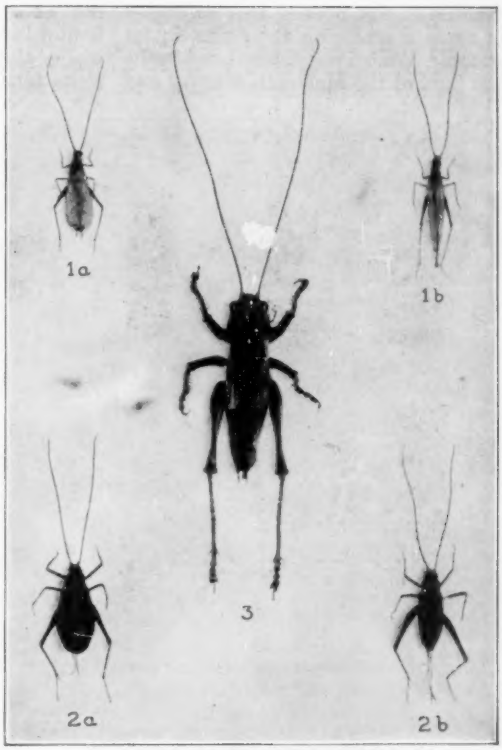
The relation of the Chinese to crickets and other insects presents one of their most striking characteristics and one of the most curious chapters of culture-historical development. In the primitive stages of life man took a keen interest in the animal world. First of all, he closely observed and studied large mammals, and next to these, birds and fishes. A curious exception to this almost universal rule is presented by the ancient Chinese.

THEY were more interested in the class of insects than in all other groups of animals combined; while mammals, least of all, attracted their attention. Their love of insects led them to observations and discoveries which still elicit our admiration. The curious life-history of the cicada was known to them in early times, and only a nation which had an innate sympathy with the smallest creatures of nature was able to penetrate into the mysterious habits of the silkworm and present the world with the discovery of silk. The cicada as an emblem of resurrection, the praying-mantis as a symbol of bravery, and many other insects play a prominent role in early religious and poetical conceptions as well as in art, as shown by their effigies in jade.

In regard to mammals, birds, and fishes, Chinese terminology does not rise above the ordinary, but their nomenclature of insects is richer and more colorful than that of most languages. Not only do they have a distinct word or even several terms for every species found in their country, but also numerous poetic and local names for the many varieties of each species for which words are lacking in English and other tongues.

In their relations to crickets the Chinese have passed through three distinct periods: during the first period running from the times of early antiquity down to the T'ang dynasty, they merely appreciated the cricket's powerful tunes; under the T'ang (A.D. 618-906) they began to keep crickets as interned prisoners in cages to be able to enjoy their concert at any time; finally, under the Sung (A.D. 960-1278) they developed the sport of cricket-fights and a regular cult of the cricket.

The praise of the cricket is sung in the odes of the *Shi king*, the earliest collection of Chinese popular songs. People then enjoyed listening to its chirping sounds, while it moved about in their houses or under their beds. It was regarded as a creature of good omen, and wealth was predicted for the families which had many crickets on their hearths. When their voices were heard in the autumn, it was a signal for the weavers to commence their work.



CRICKET TYPES

1a *and* 1b *show yellowish tree cricket, male and female;* 2a *and* 2b, *black tree cricket;* 3 *shows katydid*

CRICKET GOURDS

Note the exquisite molded design of one in lower left corner. Covers are of carved ivory or white jade

The sounds produced by the mitred cricket recall to the Chinese the click of a weaver's shuttle. One of its names therefore is *tsu-chi*, which means literally "one who stimulates spinning." "Chicken of the weaver's shuttle" is a term of endearment for it.

As it happened in China so frequently, a certain custom first originated in the palace, became fashionable, and then gradually spread among all classes of the populace. The women enshrined in the imperial seraglio evidently found solace and diversion in the company of crickets during their lonesome nights. Instead of golden cages, the people availed themselves of small bamboo or wooden cages which they carried in their bosom or suspended from their girdles.

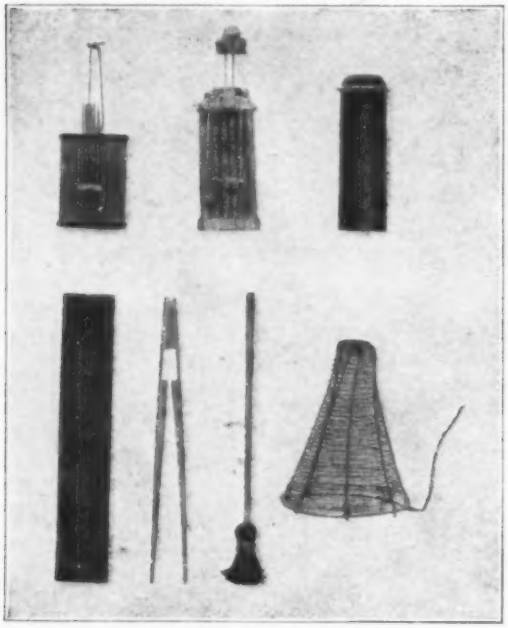
There are various methods of catching crickets. They are usually captured at evening. In the north of China a lighted candle is placed near the entrance of their hole, and a trap box is held in readiness. Attracted by the light, the insects hop out of their retreats, and are finally caught in the traps made of bamboo or ivory rods. Some of these ivory traps are veritable works of art: they are surmounted by carvings of dragons, and the trap doors shut very accurately.

IN the south, men avail themselves of what is called a fire-basket (*fo lam*) which is made of iron rods and in which a charcoal fire is kept burning. This fire drives the insects out of their dens. Sometimes the cricket-hunters reach their object by pouring water into the holes where the insects hide. Sometimes they endeavor to entice them from the nest by placing at its entrance the fruit of *Nephelium longana* (*lung yen*, "dragon's eyes").

Many people rear hundreds of crickets in their homes, and have several rooms stacked with the jars which shelter the insects. The rich employ experts to look after theirs. As soon as you enter a house like this, you are greeted by a deafening noise which a Chinese is able to stand for any length of time.

During the summer the insects are kept in circular pottery jars made of a common burnt clay and covered with a flat lid, which is sometimes perforated. Many potters made a special business

of these cricket houses, and impressed on them a seal with their names; for example, Chao Tse-yü, who lived in the first part of the nineteeth century and whose productions still enjoy a special reputation. There are old pots said to go back as far as the Ming dynasty (1368-1643), and these are highly prized.



CRICKET KEEPERS' ACCESSORIES

Bamboo and ivory traps, feeding dish nippers, pot cleaning brush, frame for use while cages are cleaned

The crickets keep cool in these jars, which are often shaped in the form of a gourd, as the heat does not penetrate the thick clay walls. Tiny porcelain dishes decorated in blue and white or small bits of clay contain food and water for the insects, and they are also provided with beds or sleeping boxes of clay. Jars of somewhat larger size serve for holding the cricket-fights.

During the winter months the crickets are transferred to specially prepared gourds which are provided with loose covers wrought in open work so as to admit fresh air. This is said to be a special variety of the common gourd (*Lagenaria vulgaris*), the cultivation of which was known to a single family of Peking.

THE gourds used as cricket habitations are all artificially shaped. They are raised in earthen moulds, the flowers are forced into the moulds, and as they grow they assume the shape of and the designs fashioned in the moulds. There is accordingly an infinite variety of forms: there are slender and graceful, round and double, cylindrical and jar-like ones. Those formerly made for the palace are decorated with figures and scenes in high relief fashioned in the clay mould. The technique employed in these ancient pieces is now lost; at least they are no longer made, although there are poor modern imitations in which the surfaces are carved, not moulded.

The covers of the gourd, flat or tall, are made of jade, elephant or walrus ivory, coconut shell, and sandalwood, all elaborately decorated, partly in high relief, partly in open work, or in the two methods combined, with floral designs, dragons, lions and other animals. Gourd vines with flowers and fruits belong to the most favorite designs carved in the flat ivory covers; gourd and cricket appear to be inseparable companions.

A kind of cement which is a mixture of lime and sandy loam is smeared over the bottom of the gourd to provide a comfortable resting-place for the tenant. The owner of the cricket may carry the gourd in his bosom wherever he goes, and in passing men in the street you may hear the shrill sound of the insect from its warm and safe place of refuge. The gourds keep the insects warm, and on a cold night they receive a cotton padding to sleep upon.

In the summer the insects are generally fed on fresh cucumber, lettuce, and other greens. During their confinement in autumn and winter masticated chestnuts and yellow beans are given them. In the south they are also fed on chopped fish and various kinds of insects, and even receive honey as a tonic.

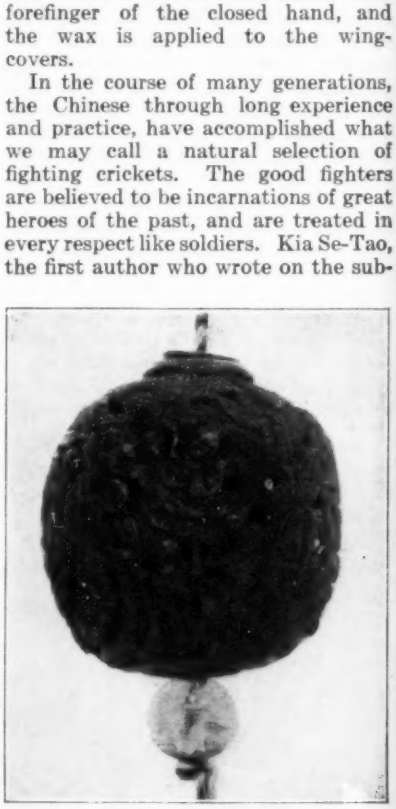
IT is quite a common sight to see the idlers congregated in the tea-houses and laying their crickets out on the tables. Their masters wash the gourds with hot tea and chew chestnuts and beans to feed them. Then they listen to their songs and boast of their grinding powers. The Chinese cricket books give many elaborate rules for proper feeding which vary with the different species and with every month.

The fighting crickets receive particular attention and nourishment, a dish consisting of a bit of rice mixed with fresh cucumbers, boiled chestnuts, lotus seeds, and mosquitoes. When the time for the fight draws near, they get a tonic in the form of a bouillon made from the root of a certain flower. Some fanciers allow themselves to be stung by mosquitoes, and when these are full of blood, they are given their favorite pupils. In order to stir their ferocity prior to a bout, they are sometimes also compelled to fast. As soon as it is recognized from their slow movements that they are sick, they are fed on small red insects gathered in water.

A tickler is used for stirring the crickets to incite them to sing. In Peking fine hair from hare or rat whiskers inserted in a reed or bone handle is utilized for this purpose; in Shanghai, a fine blade of crab or finger grass. The ticklers are kept in bamboo or wooden tubes, and the rich indulge in the luxury of having an elegant ivory tube surmounted by the carving of a lion.

THE tympanum of good singers is coated with a bit of wax to increase or strengthen the volume of sound. A small needle about three inches long with blunt end, about the size of a darning needle, is heated over a candle and lightly dipped in the wax. The insect is held between the thumb and forefinger of the closed hand, and the wax is applied to the wing-covers.

In the course of many generations, the Chinese through long experience and practice, have accomplished what we may call a natural selection of fighting crickets. The good fighters are believed to be incarnations of great heroes of the past, and are treated in every respect like soldiers. Kia Se-Tao, the first author who wrote on the subject, says that "rearing crickets is like rearing soldiers." The strongest and bravest of these who are most appreciated at Peking and Tientsin come from the southern province of Kwang-tung. These fighters are dubbed "generals" or "marshals," and seven varieties of them are distinguished, each with a special name.



CARVED WALNUT SHELL

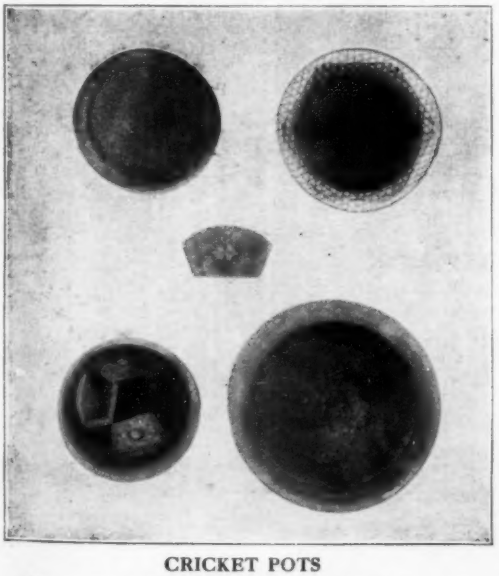
For keeping singing crickets—usually carried in the girdle. Note intricate design

Those with black heads and gray hair in their bodies are considered best. Next in appreciation come those with

yellow heads and gray hair, then those with white heads and gray hair, then those with golden wings covered with red hair, those of yellow color with blood-red hair, who are said to have two tails in form of sheep's horns, finally those yellow in color with pointed head and long abdomen and those supposed to be dressed in embroidered silk, gray in color and covered with red spots like fish-scales. The good fighters, according to Chinese experts, are recognized by their loud chirping, their big heads and necks, long legs, and broad bodies and backs.

THE "Generals," as stated, receive a special diet before the contest, and are attended to with utmost care and great competence. Observations made for many centuries have developed a set of standard rules which are conscientiously followed. The trainers, for instance, are aware of the fact that extremes of temperature are injurious to the crickets. When they observe that the insects droop their tiny mustaches, they know that they are too warm, and endeavor to maintain for them an even temperature and exclude all draughts from them. Smoke is supposed to be detrimental to their health, and the rooms in which they are kept must be perfectly free from it.

The experts also have a thorough understanding of their diseases, and have prescriptions at hand for their treatment and cure. If the crickets are sick from overeating, they are fed on



CRICKET POTS

The summer habitations of the insects. The one in lower left-hand corner contains clay beds in which they sleep

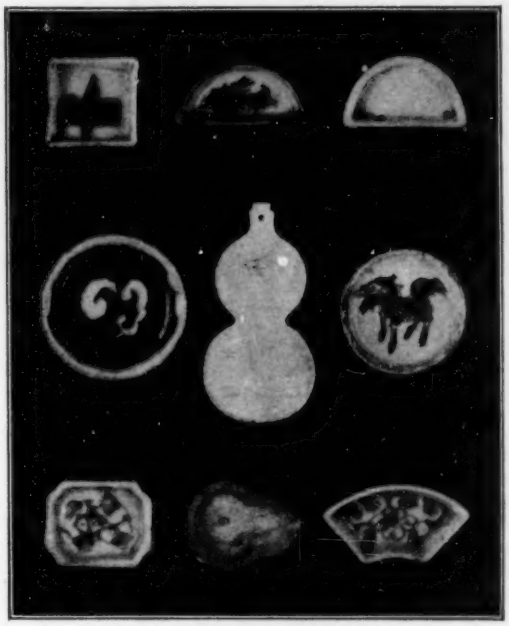
a kind of red insect. If sickness arises from cold, they get mosquitoes; if from heat, shoots of the green pea are given them. A kind of butterfly known as "bamboo butterfly" is administered for difficulty in breathing. In a word, they are cared for like pet babies.

The tournaments take place in an open space, on a public square, or in a special house termed Autumn Amusements. There are heavy-weight, middle and light-weight champions. The wranglers are always matched on equal terms according to size, weight, and color, and are carefully weighed on a pair of tiny scales at the opening of each contest. A silk cover is spread over a table on which are placed the pottery jars containing the warring crickets. The jar is the arena in which the prize fight is staged.

As a rule, the two adversaries facing each other will first endeavor to flee, but the thick walls of the bowl or jar are set up as an invincible barrier to this attempt at desertion. Now the referee who is called "Army Commander" or "Director of the Battle" intercedes, announcing the contestants and reciting the history of their past performances, and spurs the two parties on to combat. For this purpose he avails himself of the tickler described above, and first stirs their heads and the ends of their tails, finally their large hind legs.

The two opponents thus excited stretch out their antennae which the Chinese not inaptly designate "tweezers," and jump at each other's heads. The antennae or tentacles are their chief weapons. One of the belligerents will soon lose one of its horns, while the other may retort by tearing off one of the enemy's legs. The two combatants become more and more ferocious and fight each other mercilessly. The struggle usually ends in the death of one of them, and it occurs not infrequently that the more agile or stronger one pounces with its whole weight upon the body of its opponent, severing its head completely.

Cricket-fights in China have developed into a veritable passion. Bets are concluded, and large sums are wagered on the prospective champions. The stakes are in some cases very large, and at single matches held in Canton, are said to have sometimes aggregated $100,000. It happens quite frequently that too ardent amateurs are completely ruined in the game. Gambling is forbidden by law in China as elsewhere, but such laws are usually winked at, and the official



FEEDING PLATES

Of delicate porcelain. In center is an ivory, gourd-shaped tablet on which names of champions are inscribed

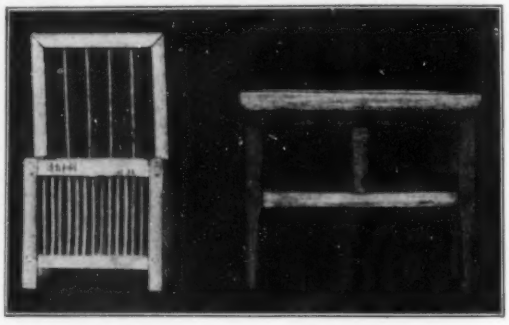
theory in this case is that stakes consist of presents of sweet cakes.

Choice champions fetch prices up to $100, the value of a good horse in China, and owners of famous crickets travel long distances to meet their competitors and congregate with them in order to match their champions. Some amateurs delight in raising them by the hundreds in the hope of producing the champion of the champions of the season, who is honored with the attribute of Grand Marshal. These men are by no means low-brows, but highly cultured men, and those in responsible government positions are found in this class.

TWO localities near Canton, Fa-ti and Cha-pi, not far from Whampoa, enjoy a special reputation for cricket-fighting. At these places extensive mat sheds are erected and divided into several compartments. In each section a contest goes on, the pot which forms the arena being placed on a table. In order to acquaint prospective betters with the merits of the crickets matched against each other, a placard is posted on the sides of the building, setting forth the various stakes previously won by each cricket. Great excitement is manifested at these matches, and considerable sums of money change hands.

The sum of money staked on the contest is lodged with a committee who retain ten percent to cover expenses

and hand over the balance to the owner of the winning cricket. The lucky winner is also presented with a roast pig, a piece of silk, and a gilded ornament resembling a bouquet of flowers. This decoration is deposited by him either on the ancestral altar of his house to inform his ancestors of his good luck and to thank them for their protection, or on a shrine in honor of Kwan-ti, a deified hero, who is the personification of all manly virtues and a model of gentlemanly conduct.



CAGES

In Shanghai and Hangchow, grasshoppers are also held captive, usually being kept in wooden cages rather fancifully shaped like tables, chairs, or similar articles of furniture. Cicadas were formerly also kept in small cages which were suspended from the eaves of the house or from branches of trees, but this custom is no longer practised. However, boys sometimes cage them

The names of the victorious champions are inscribed on an ivory tablet carved in the shape of a gourd, these tablets like diplomas are ... iously kept in the houses of the fo... nate owners. Sometimes the characte... of the inscription are laid out in gold. The victory is occasion for great rejoicing and jollification. Music is performed, gongs are clanged, flags displayed, flowers scattered, and the tablet of victory is triumphantly marched in front, the jubilant victor struts in the procession of his overjoyed compatriots, carrying his victorious cricket home. The sunshine of his glory falls on the whole community in which he lives, and his village will gain as much publicity and notoriety as an American town which has produced a golf or baseball champion.

In southern China, a cricket which has won many victories is honored with the title "conquering or victorious cricket" (*shou lip*); on its death it is placed in a small silver coffin, and is solemnly buried. The owner of the champion believes that the honorable interment will bring him good luck and that excellent fighting crickets will be found in the following year in the neighborhood of the place where his favorite cricket lies buried.

ALL these ideas emanate from the belief that able cricket champions are incarnations of great warriors and heroes of the past from whom they have inherited a soul imbued with prowess and fighting qualities. Dickens says, "For all the Cricket Tribe are potent Spirits, even though the people who hold converse with them do not know it (which is frequently the case)."

A proverbial saying with reference to a man who failed or has been defeated is, "A defeated cricket—he gives up his mouth," which means as much as "throwing up the sponge."

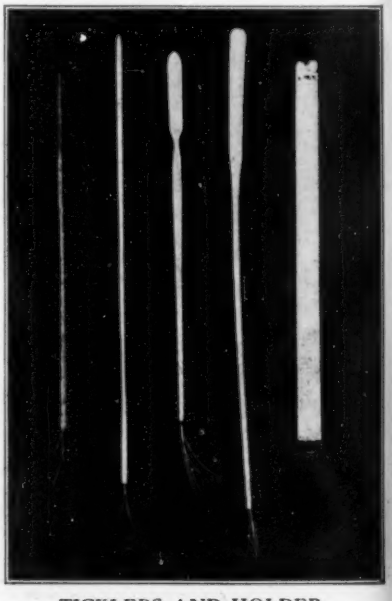
The following Chinese stories may give an insight into the cricket rage.

Kia Se-tao, a minister of state and general who lived in the thirteenth century, and who wrote, as mentioned, an authoritative treatise on the subject, is one of the cricket fanciers famous in history. He was completely obsessed with an all-absorbing passion for the cricket cult. The story goes that one day, during a war of the Mongols against the imperial house of Sung, an important city fell into the hands of the foe. When Kia Se-tao received news ... the disaster, he was found kneeling ... the grass of a lawn and taking part in a cricket fight. "In this manner you look out for the interests of the nation!" he was reprimanded. He was not in the least disturbed, however, and kept his attention concentrated on the game.

AN anecdote of tragical character is told with reference to an official of Peking, who held the post of director of the rice-granaries of the capital. He once found a cricket of choice quality and exceptional value. In order to secure this treasure, he exchanged his best horse for it and resolved to present this fine specimen to the emperor. He placed it cautiously in a box and took it home. During his absence his prying wife craved to see the insect which had been bought so dearly. She opened the box, and fate ordained that the cricket made its escape. A rooster happened to be around and swallowed the cricket. The poor woman, frightened by the consequences of her act, strangled herself with a rope. At his return the husband learned of the double loss he had suffered and, seized by despair, committed suicide. The Chinese narrator of the story concludes, "Who would have imagined that the graceful singer of the fields might provoke such a tragedy as this?"

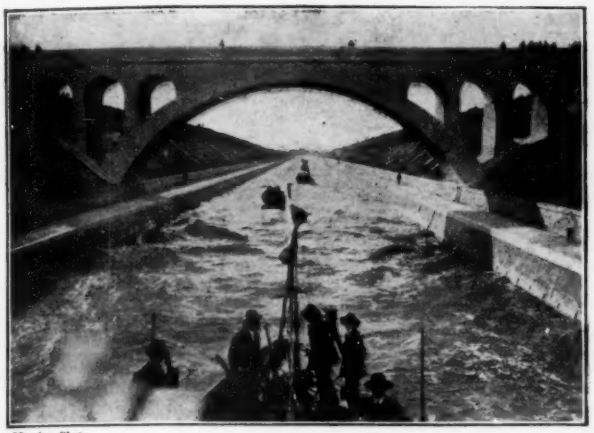
During the period 1426-36, a magistrate, wishing to befriend the governor, presented him with a cricket which proved to be a remarkable fighter. Thereupon the governor ordered the beadles of his district to keep him supplied with crickets. Their price rose very high, and when the beadles sent for a single one it was enough to ruin several families. One man found a handsome cricket which he proceeded to feed carefully in a bowl. His son, curious to see the specimen, accidentally let the cricket escape. The son attempted suicide and when revived, was found to have lost his mind. The father that evening found a small cricket which, when set to fight, vanquished all others. This he presented to the governor and the governor, in turn, showered him with honors. After six months, the son recovered and said his spirit had gone into the cricket and he had fought skillfully to amend the loss he had caused his father.

AS far as is known, China is the only nation that has developed cricket-fights. The Japanese, although fond of chirping insects, which they keep as pets in little cages, do not use them for fighting purposes. Kipling writes in his Jungle-book, "The herd-children of India sleep and wake and sleep again, and weave little baskets of dried grass and put grasshoppers in them; or catch two praying-mantises and make them fight." This may be an occasional occurrence in India, but it has not developed into a sport or a national pastime. In regard to Japan the reader may be referred to Lafcadio Hearn's essays "Insect-Musicians," inserted in his "Exotics and Retrospectives," and "Semi" [Cicada] in his "Shadowings."



TICKLERS AND HOLDER

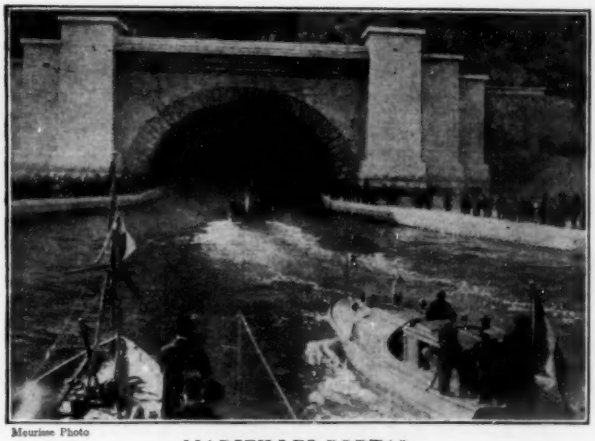
For inciting crickets to sing or fight: of rat or hare whiskers in reed, bone, or ivory



Meurisse Photo

INTO THE OPEN

Boats carrying the president of France and party at the opening day celebration, passing from tunnel mouth into the open canal



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MARSEILLES PORTAL

Massive stone work and beauty are salient features of the entrances. Comparison with large power boats and people will indicate size

Underground Canal an Engineering Feat

Sea Trip from Mouth of Rhone to City of Marseilles Eliminated by Canal Tunnel

SINCE Marseilles, long a leading port of the Mediterranean, had no water connection with the interior, the completion of the Rove Tunnel link in the canal leading to the Rhone River, marks an epoch in the progress of the city.

Largest of its kind in Europe, both as to length and cross-section, this tunnel will allow passage of river boats that previously found it practically impossible to negotiate the 30-mile sea trip from the mouth of the Rhone to Marseilles.

It is 72 feet wide, 51 feet high from top to ground, and has a tow path six feet wide along each wall. Total length is 23,900 feet, or 8900 feet longer than the similar canal tunnel from the Marne to the Rhine. At each end of the tunnel there is a handsome portal entrance, that nearest Marseilles being 200 feet long and 70 feet wide.

Fifteen years were required to complete the Rove Tunnel, and its cost, estimated in round numbers at 135,000,000 francs, or 6000 francs a running foot, was borne by the French government, the city of Marseilles, and the Chamber of Commerce. This debt is to be cleared off by future toll charges.

THE cross-sectional area of the Rove Tunnel is about six times that of an average double-tracked railroad tunnel. More material was taken from this than from any other tunnel in Europe, figures showing that 60,000,000 cubic feet were removed, as compared to 48,000,000 from the Simplon, 22,000,000 from St. Gotthard, and 30,000,000 from the Lötschberg.

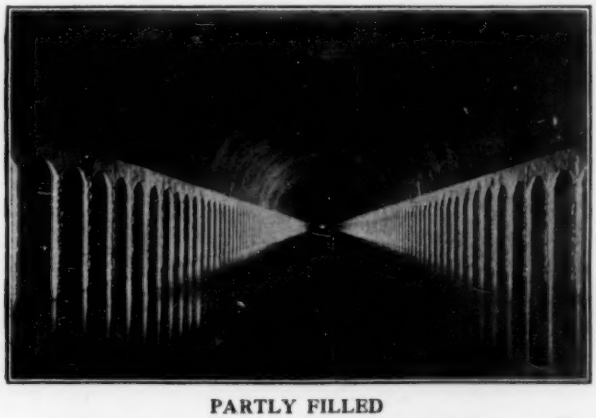
The masonry lining above the water represents 75,000,000 cubic feet of stone; that below water, the basin, 3,000,000 cubic feet. Cement required for the bottom of tunnel was 1,000,000 cubic feet; for the tow paths 360,000 cubic feet; and for the access trench, 2,000,000 cubic feet.

A novel method of construction was followed by the builders. Starting at the spring of the arch, a semi-elliptical outline was cut inward for 10 or 12 feet to give space for the stone arch, which was laid on timber supports. After the walls were built, the material in the center was removed, the basin dug, and the tow path constructed.

Meurisse Photo

ENTERING TUNNEL

Crowds witnessed the opening ceremonies and many officials passed through the new canal tunnel in boats with the presidential party



PARTLY FILLED

Beautiful perspective view showing perfect arch construction and tow paths. A subway straphanger would be lost in this silence

The Atmosphere

What's In It?

By W. J. HUMPHREYS, Ph.D.
Professor of Meteorological Physics, United States Weather Bureau; Member American Geophysical Union

ONLY about one fifth as many years ago as there are dollars in our public debt, there wasn't any atmosphere nor earth to have an envelope of any kind. The whole solar system, including the Sun itself, was all combined in one single star of no particular distinction.

Then another star of much greater mass, if we accept the conclusions of master astronomers, came sweeping by our Sun only a few radii distant, and tore off from it by tidal action all the material that later coalesced into planets and satellites. The iron and other metallic vapors thus pulled out from the Sun evidently formed the cores of the planets, while the lighter non-metallic elements combined partly with the metals, partly with each other, and in part remained free, if they existed in sufficient quantity. In this way, we believe, the earth acquired great oceans, as soon as its surface had cooled below the boiling point of water, and a gaseous atmosphere.

But the quantity of water on the earth and the amounts of the several constituents of the atmosphere have varied from the beginning and are still varying. Every active volcano is a water fountain and an air jet. It gives off today, as other volcanoes and lava flows must have from the first, great volumes of water vapor, carbon dioxide, nitrogen, and several other gases. Presumably, however, few if any volcanoes yield free oxygen, as obviously they cannot at high temperatures along with free sulfur and free hydrogen, both of which seem generally if not invariably to be present. We may assume, then, that the oxygen now in the atmosphere has been there from the beginning of terrestrial time, with only minor additions and subtractions.

All of us usually think of the atmosphere, and most of us always think of it, as being just air—a single substance the same in every part. Nevertheless, the atmosphere is very complex, and a little about this condition has been known a long while.

Aristotle, and many others after him, insisted that clouds and rain are caused by the condensation out of the air of water vapor previously evaporated from the surface of the earth. Perhaps this correct idea was already old in Aristotle's day and only transmitted by him to later generations. But be that as it may, it is clear that although the Greeks called the air an element, they really believed it to be complex, at least to the extent of consisting of water vapor and of something else. And this is all that was known about its composition until the middle of the eighteenth century.

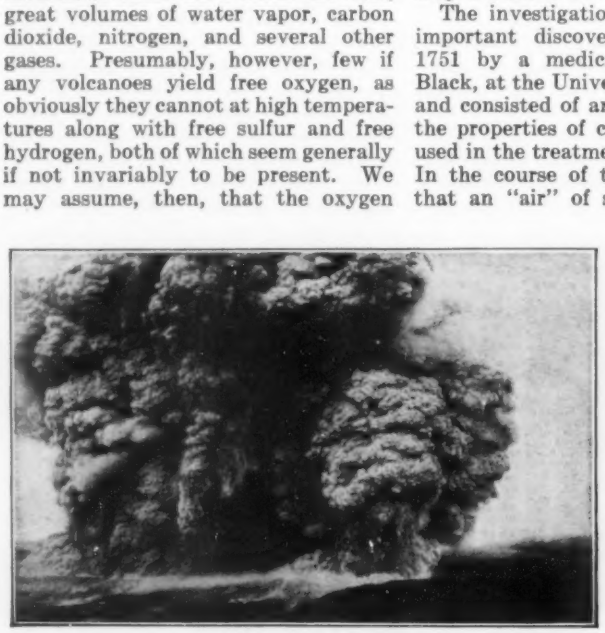
THE first gas found to be a constituent of the atmosphere was not the most abundant, as one might suspect, but carbon dioxide, so small a portion of the whole as to be relatively only a mere trace.

The investigations that led to this important discovery were begun in 1751 by a medical student, Joseph Black, at the University of Edinburgh, and consisted of an extensive study of the properties of certain alkalies then used in the treatment of urinal calculi. In the course of this work he found that an "air" of some kind is given off by alkali carbonates—calcium carbonate or limestone, for example—when strongly heated, and that the residue when exposed to the free air reverts to its initial condition. This gas, which we call carbon dioxide from its now known composition, Dr. Black called "fixed air" because it is "fixed" in the carbonates with which he worked.

The next atmospheric gas found was nitrogen, the most abundant constituent. This discovery also was made by a medical student at the University of Edinburgh, Daniel Rutherford. The particular investigation that led to this important result was undertaken at the suggestion of the discoverer of carbon dioxide, Dr. Joseph Black, then professor of chemistry, and published in 1772.

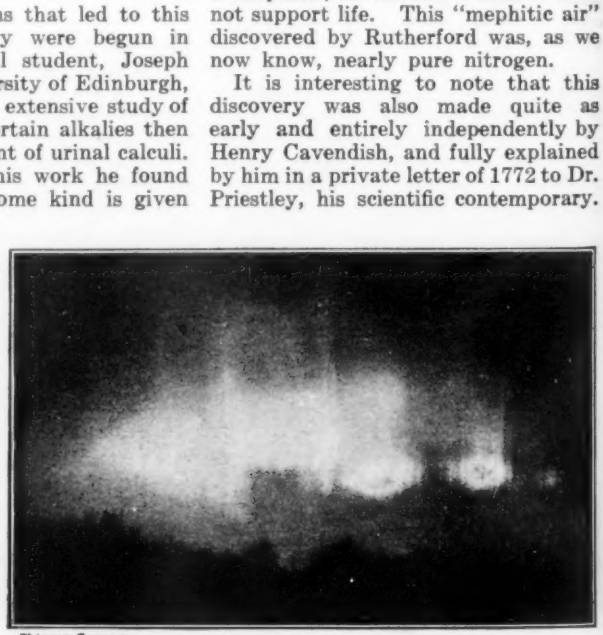
The procedure consisted essentially of burning certain substances in a limited volume of air, then absorbing in alkalies the carbon dioxide thus produced, if any, and examining the gas that remained. This residual air is not "fixed air" or carbon dioxide, because caustic alkalies will not absorb it, and it is not the same as the air we breathe, for animals confined to it alone quickly die. It is therefore another portion of the atmosphere and is mephitic, in the sense that it does not support life. This "mephitic air" discovered by Rutherford was, as we now know, nearly pure nitrogen.

It is interesting to note that this discovery was also made quite as early and entirely independently by Henry Cavendish, and fully explained by him in a private letter of 1772 to Dr. Priestley, his scientific contemporary.



AN AIR FACTORY (MT. KILAUEA)

Although the earth's atmosphere has always been approximately fixed in quantity, volcanoes add slightly to the total



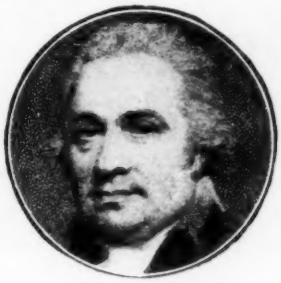
Fleetgram Company

SIXTY MILES UP—THE AURORA

The aurora tells us a great deal concerning the composition of the highest part of the earth's atmosphere above 60 miles

ARISTOTLE

BLACK



RUTHERFORD

CAVENDISH

Almost immediately after the discovery of nitrogen, the Swedish chemist, Carl Wilhelm Scheele, and the English preacher, Joseph Priestley, who later moved to America, both discovered the oxygen of the atmosphere; Scheele, according to his laboratory notes, having the priority of discovery, before 1773, and Priestley the priority of publication.

As early, then, as 1775 it was known that the atmosphere consists essentially of nitrogen, which both its discovers, Rutherford and Cavendish, called "mephitic air;" oxygen, generally then called "dephlogisticated air;" carbon dioxide, or "fixed air;" and water vapor. For more than a century no additional constituent of the atmosphere was found except mere traces here and there of ammonia, sulfuretted hydrogen, and the like. We quit bothering about the composition of the atmosphere, and wholly forgot the fact that Cavendish had found a portion of it to be different from any of its known constituents.

No wonder, therefore, that the whole scientific world was amazed when in 1894 Lord Rayleigh and Sir William Ramsay announced the discovery of another constituent more abundant than the water vapor, carbon dioxide, and everything else except the nitrogen and oxygen all combined. This gas, known as "argon," undoubtedly is the same thing that Cavendish had found so intractable.

The surprising find of argon naturally led to new and most searching studies and analyses of the atmosphere, and the quick discoveries of helium, neon, krypton, and xenon—all like argon in being chemically inert. Every minute analysis of the atmosphere seems also to show the presence of free hydrogen in small amounts.

According to the latest careful determinations, the volume percentages of the several constituents of perfectly dry, free or pure air, at the surface of the earth, are:

Nitrogen	78.03
Oxygen	20.99
Argon	0.9323
Carbon dioxide	0.03
Hydrogen	0.01
Neon	0.0018
Helium	0.0005
Krypton	0.0001
Xenon	0.000009

The quantity of water vapor in the atmosphere varies from a mere trace when the temperature is far below zero, to 5 percent or more in favorable regions when the temperature is quite high. On the average, however, its total amount is the equivalent of a sheet of water about one inch thick over the whole earth.

From the known composition of the atmosphere, its pressure at sea level, the heights and extents of continents, and the distribution of air temperature, it is obviously quite possible to compute the mass of the whole and of each constituent. This shows its total mass, average amount of water vapor and all, to be about 511×10^{16} kilograms, or, roughly, 5633 million million tons, and that of xenon, the least abundant of the constituents, 17×10^{11} kilograms, or approximately 1874 million tons.

The percentages of the several constituents of the atmosphere vary greatly with height. Water vapor is confined almost entirely to the lower atmosphere. This is because the amount of it that can exist in a given space decreases rapidly with decrease of temperature, which in turn decreases with increase of height, not indefinitely, but to so low a value, -60 degrees Fahrenheit, or lower, that extremely little water vapor can remain. In the high atmosphere, that is, beyond eight to ten miles above the surface, there is very little vertical convection and general mixing, hence in this region the percentages of the heavier gases must decrease with increase of height and those of the lighter increase.

Meteors tell us nothing whatever of the composition of the upper air; they only give some idea of its extent and density. Auroras, on the other hand, reveal very little about its density, but a great deal as to what elements are present. Their spectrum does not show hydrogen, but this is no proof of its absence, as the same is true of helium which surely must be present. It does show, however, that the upper air consists, in part at least, of nitrogen and oxygen.

Oxygen appears to be monatomic in the auroral levels, 60 miles and more above the earth. If it is, then it plays the role of three distinct gases. In the lower atmosphere it is diatomic, two atoms to the molecule. Somewhere in the upper but not outermost air much of it is triatomic, the form known as ozone, and finally, at still greater heights, monatomic. We are sure of the diatomic and triatomic forms and their locations, and practically sure also of the monatomic.

Of all the atmosphere, it is the higher portions that offer now the best opportunities for investigation, and about which we most eagerly await further information.

PRIESTLEY

SCHEELE

RAYLEIGH

RAMSAY

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

A New Automatic Blood Pressure Instrument

EVERY one who has visited the office of a modern physician is familiar with the instrument by which he measures the blood pressure. Usually this is either a column of mercury, which is raised when the cuff applied about the arm is inflated so as to interfere with the flow of blood through the blood vessels, or else a spring instrument which records by pressure on the spring the amount of pressure in the blood vessels. For a normal man, the blood pressure is between 120 and 130, with additions as he grows older.

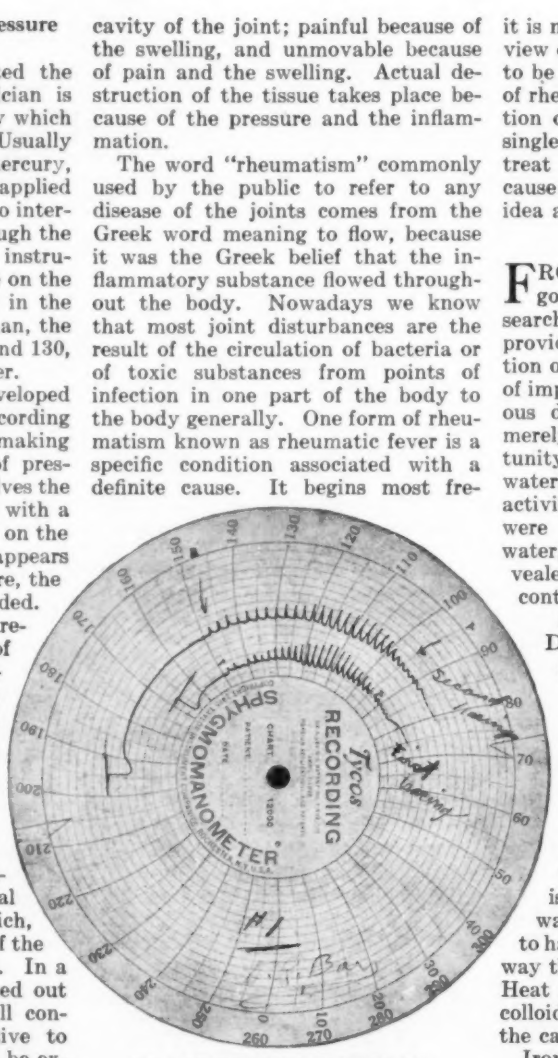
A new instrument just developed provides for the automatic recording of the pressure on a chart, making possible a permanent record of pressure at any given time. It involves the connection of a metal chamber with a pen, which traces a smooth line on the chart. When the pulse beat disappears at the highest point of pressure, the systolic blood pressure is recorded. As the pressure on the arm is released through the deflation of the cuff, the instrument indicates the deflation and then indicates the diastolic blood pressure. A sample tracing of a characteristic curve for a man of 50 years of age appears in the illustration.

Disease of the Joints

FRIEDRICH VON MUELLER, director of the Medical Clinic in the University of Munich, Germany, is recognized as one of the leading physicians of the world. In a recent formal address he pointed out some of the problems that still confront scientific medicine relative to disease of the joints. As might be expected in a Germanic approach to this subject, Von Mueller bases most of his conclusions on the changes that have actually taken place in the tissue in such diseases, following here the leadership of the most famous of all pathologists, Virchow.

However, in the very beginning of the Christian era, the great Roman physician Celsus described inflammation as a condition consisting of the following symptoms: rubor, calor, tumor, dolor and functio laesa. An inflamed joint is hot and red from the increased flow of blood; is swollen through the pouring of blood into the cavity of the joint; painful because of the swelling, and unmovable because of pain and the swelling. Actual destruction of the tissue takes place because of the pressure and the inflammation.

The word "rheumatism" commonly used by the public to refer to any disease of the joints comes from the Greek word meaning to flow, because it was the Greek belief that the inflammatory substance flowed throughout the body. Nowadays we know that most joint disturbances are the result of the circulation of bacteria or of toxic substances from points of infection in one part of the body to the body generally. One form of rheumatism known as rheumatic fever is a specific condition associated with a definite cause. It begins most frequently between the tenth and thirtieth year. Not infrequently the heart is affected and chorea or St. Vitus' dance is an associated manifestation.



BLOOD-PRESSURE RECORD

First curve—systolic pressure 147, diastolic pressure 94. Second tracing—systolic pressure 147, diastolic pressure 95

There are some cases of joint inflammation such as gout, which seem to be the result of disturbance of metabolism, with the development of toxic substances.

The final conclusions of Von Mueller are that diseases of the joints and bones are as varied as disease itself, and that it is necessary to take a much broader view of the many conditions that used to be lumped under the single heading of rheumatism. It is a significant portion of modern scientific diagnosis to single out the specific cause and to treat the condition according to the cause rather than to follow any one idea as to the causation of all disease.

Mineral Springs

FROM the earliest times men have gone to mineral-spring resorts in search of health. Some of the springs provide water containing a combination of minerals or salts which may be of importance in the treatment of various diseases, some of them provide merely a change of scene and the opportunity for hot and cold baths. Some waters have high degrees of radioactivity. Certain waters in Austria were known distinctly as "goiter water," and modern chemistry has revealed the fact that these waters contain iodine in every instance.

Drs. Oskar Baudisch and David Davidson of the Rockefeller Institute for Medical Research have recently made available a consideration of the catalytic action of the water of Saratoga Springs. Apparently the water from this spring has a high catalytic activity which is dependent on its content of ferrous iron. The bottled waters retain their catalytic activity if oxygen is extracted in the bottling. The waters before bottling were found to have a much higher activity in this way than any European spring water. Heat and light alter the dispersion of colloid particles, but do not weaken the catalytic activity.

Iron, as the authors pointed out, is one of the most important elements in human biology. It is the common remedy in the treatment of anemia; it is the integral constituent of the blood, acting to carry oxygen and therefore indispensable to breathing; it serves as a source of energy in the assimilation of carbonic acid.

The authors believe that mineral waters forced to the surface have physico-chemical properties different from those of waters which have been aged for some time. Apparently these have to do with the complex chemical substances that are contained and with the reaction of these substances with-

in the bodies of mineral water users.

The new knowledge that has been made available as to the physical effects of minerals in the body has opened up anew the entire question of the effects of mineral waters. It is necessary to restudy the situation with the newer knowledge in mind.

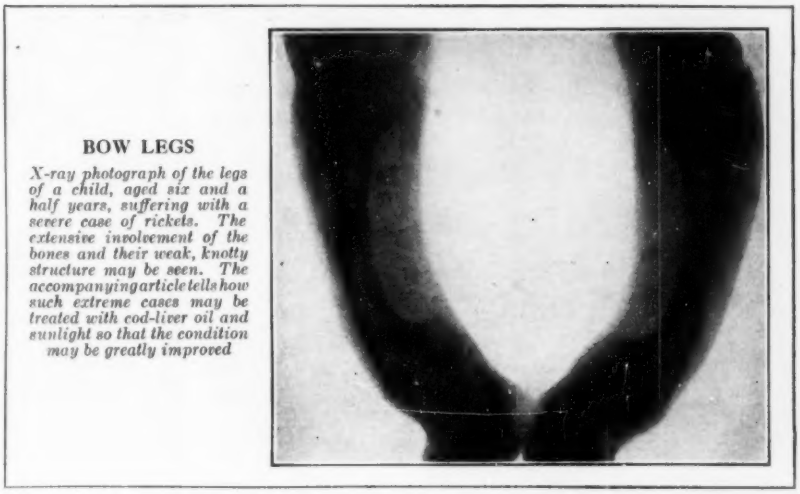
Rickets

ONE of the outstanding discoveries of the past decade has been the fact that rickets may be treated successfully by the use of sunlight and cod-liver oil and that it may be prevented by the same measures. If the condition is discovered early, the results under proper treatment are satisfactory. If it is discovered later, however, the treatment is inadequate and the results are disappointing. Dr. Max W. Bloomberg has described the treatment of persistent rickets in children over two years of age who have not been properly treated and in whom the disease persisted.

The child with rickets is undersized, has extreme bow-legs, its chest is marked with little lumps where the cartilage joins the ribs, it is likely to have a "pot-belly" or large abdomen, and it has little resistance against disease. The epiphyses of the bones or the heads of the bones are enlarged and thin. Severe cases of rickets tend to persist. It has been shown that it is only necessary to increase greatly the dosage of the treatments to overcome these severe cases. The cod-liver oil is given in these cases in amounts of one teaspoonful three times a day and the children are kept out-of-doors almost continually so that they become completely tanned. In some cases even this amount of cod-liver oil was insufficient and the dosage was increased up to three teaspoonfuls three times a day.

SEVERE RICKETS CASE

The leg structure of this child is shown in X-ray photograph above



BOW LEGS

X-ray photograph of the legs of a child, aged six and a half years, suffering with a severe case of rickets. The extensive involvement of the bones and their weak, knotty structure may be seen. The accompanying article tells how such extreme cases may be treated with cod-liver oil and sunlight so that the condition may be greatly improved

A deficiency either in the diet or in the sunlight may produce the disease and when both deficiencies are present, it is necessary to give much greater amounts of treatment. When rickets persist beyond the second year under ordinary treatment, the measures advocated must be considered by the physician.

A Patient Without a Gall-bladder

INCREASING delicacy of modern diagnosis, including the use of dye substances which, when injected into the body, make the gall-bladder opaque to the Roentgen ray, have brought about increasingly frequent diagnosis of inflammation of the gall-bladder or of the presence of gallstones. A consultation of medical records of 50 years ago fails to reveal anything like the present frequency of this condition.

Unquestionably an inflamed gall-bladder makes its possessor irritable and a generally unsatisfactory cuss in every way. It was with surprise, therefore, if not with pleasure, that a physician recently found in New York City a woman, aged 59, who suffered with symptoms resembling those of gall-bladder disease, but who was found on examination to be entirely without such an organ. When the dye substance was injected the shadow of the gall-bladder could not be found on the X-ray plates. The use of the method by which bile may be pumped out by the stomach pump failed to reveal the presence of bile coming from the gall-bladder.

An eminent surgeon much given to epigrams stated that the patient who suffered with gall-bladder disturbances was usually "fair, fat, forty, and belching." Since the patient met most of these requirements, in addition to providing other symptoms of importance, it was decided to do an exploratory operation. Here the interesting condition found was a complete absence of the gall-bladder, but some evidence of chronic inflammation of the appendix, indeed sufficient to account for the patient's symptoms. All of the findings relative to the bile were such as to indicate a difficulty with the gall-bladder if one existed, but the possibility of a congenitally absent gall-bladder, because of its rarity, hardly entered the diagnostician's mind.

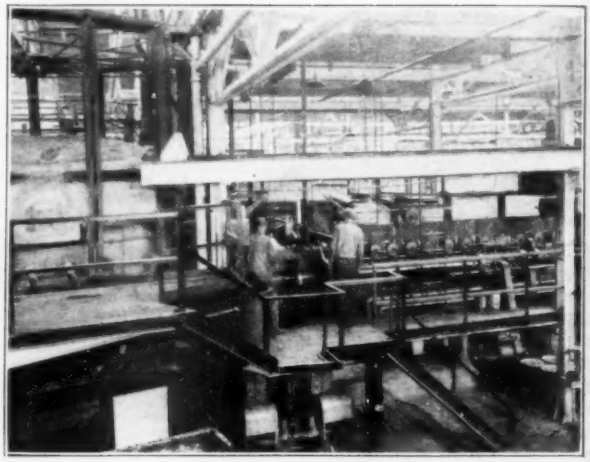
Spinach

OF all the vegetables spinach has the highest content of vitamin A. Weight for weight, fresh spinach is little richer than butter in this substance. Vitamin B, which has the power of preventing scurvy and which also seems to be associated in some way with the general resistance of the body to disease, is present in spinach in about the same quantities as in milk. Spinach is also valuable in providing the human body with the element calcium, so necessary for the growth of the bones and of the teeth, and apparently of importance in relation to the nervous system and to irritability. Experiments made in the nutrition laboratory of the Bureau of Home Economics of the United States Department of Agriculture revealed the fact that spinach can be used to provide 70 percent of the lime in the diet in feeding experiments in which spinach is substituted for milk.

There are, of course, thousands of people in the United States who eat little, if any, fresh vegetables and indeed who subsist largely on meat, bread and coffee. It is, therefore, a part of a modern health program to urge the eating of more fresh vegetables. The Commonwealth Fund undertook a crusade for better health in Fargo, North Dakota. As a result of health teaching in the public schools, the city, after a period of two years, consumed 10 times as much spinach as previously.

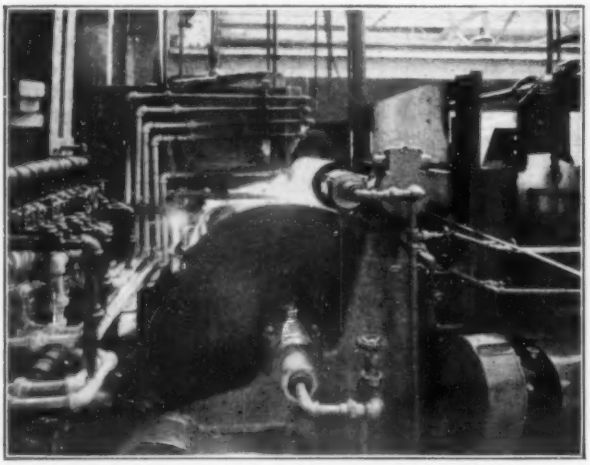
THE GLASS TANK IS OF ENORMOUS SIZE

The tank is filled with molten glass kept hot by coke-oven gas. Movable "floaters" keep back the dross. Looking towards delivery end



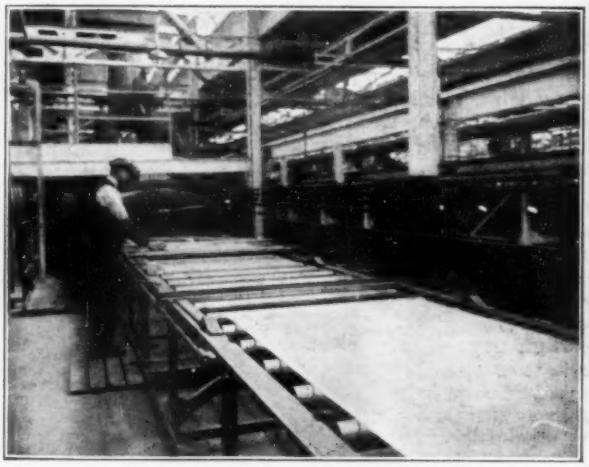
TANK END OF THE GLASS-MAKING MACHINE

The glass flows out of the tank through the aperture in the top, which may be seen between the two men standing on the elevated platform



THE BIRTH OF THE RIBBON OF GLASS

The glass flows between two water-cooled cylinders having the same surface velocity, and rolls out as a glass ribbon to begin its journey

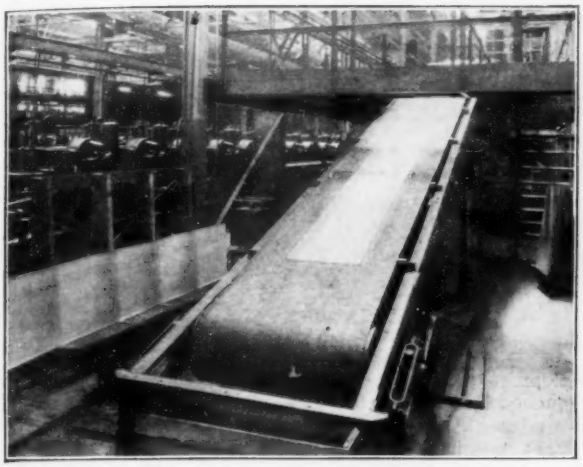


CUTTING THE GLASS AS IT COMES FROM LEHR

The lehr is 442 feet long and is adapted to cool the glass gradually in an automatically controlled heat tunnel. The glass is cut at the end

Plate Glass by the Mile

OVER 21,000,000 feet of glass a year are required by the Ford Company. More than 15,000,000 square feet a year are produced at the Fordson plant, while at Highland Park, 3,000,000 square feet are produced annually. There is also a large plate glass factory at Glassmere, Pennsylvania, which can turn out a large quantity of glass a year on the old plan of pouring and rolling. In the glass plant at Detroit, one sees the method of casting plate glass in an endless, unbroken strip, something the experts of the glass industry declared impossible. Grinding and polishing are also done by the continuous process. The system at the Highland Park and Fordson plants is of this type, the glass being melted in a tank and cast in endless strips on a moving conveyor. There is no secret as to the composition of the "batch." There is a large sign telling the visitor what he sees being melted: Silica sand, 425 pounds; soda ash, 150 pounds; limestone, 138 pounds; arsenic, 2.5 pounds; cullet (broken glass) 0-150 pounds. The batch is melted in furnaces 16 feet wide and 74 feet long tapering to 12 feet at one end. Coke gas is used as the fuel. The furnace is the Siemens type of regenerative tank furnace. So-called "floaters" in the tank keep back the dross. The glass comes out of the spout onto a large cast-iron drum 48 inches in diameter, the walls being two and one-half inches thick. The drum is kept filled with water and a temperature of 200 degrees, Fahrenheit, is attained for the water. If the drum gets too hot, the glass will stick, if too cold it will check. The upper cast-iron roll is nine inches in diameter and is also water cooled. The two rolls are geared together so that they rotate at the same surface speed. The glass ribbon is three times as wide as the spout opening, being over 40 inches wide and almost five-sixteenths of an inch thick. The temperature is 2000 degrees, Fahrenheit, at the spout and 2600 degrees, Fahrenheit, at the melting point. The glass now enters the "lehr" where the glass is annealed under gradually diminishing heat. The lehr is 442 feet long and consists of a table supporting rollers in an automatically controlled heat tunnel where the temperature is gradually reduced from 1075 degrees, Fahrenheit. The movement of the conveyor has to be absolutely even so that at no point in the 442 foot journey will the glass be subjected to the slightest distortion. The diminishing temperature problem is solved by

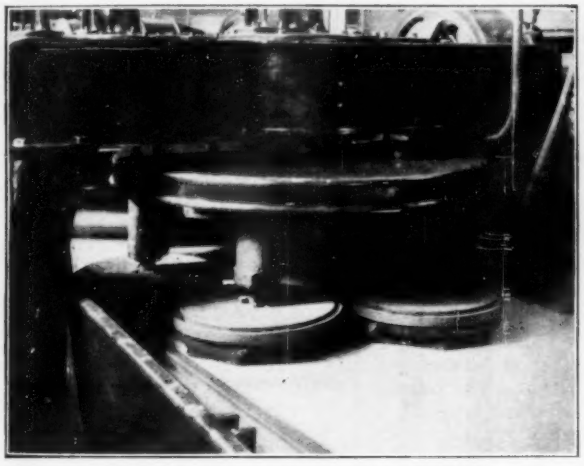


THE END OF THE JOURNEY FROM THE TANK

As the sheets of glass come down on the endless belt they are picked by men and mounted on conveyor tables for grinding and polishing

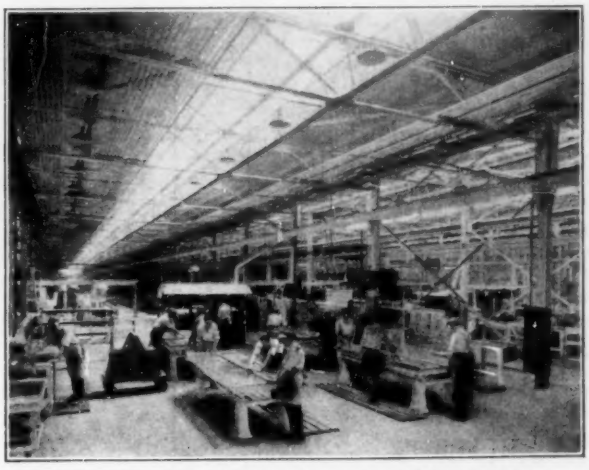
GENERAL VIEW OF THE GRINDING AND POLISHING

There are 480 of the grinding tables, each 114 inches long and 42 inches wide. The glass is cemented to the movable tables by stucco



CLOSE-UP OF THE FINISHING HEADS

There are 43 grinding heads and 36 polishing heads to finish one side. Sand and garnet are used for grinding and rouge for polishing



PACKING AND SHIPPING THE PLATE GLASS

The sheets of glass are cut to proper shipping size and are sent to the assembling plants, where they are again cut to fit the various frames

thermostatically controlled gas flames at varying intervals. At the end of the lehr the glass is cut into 113-inch lengths, each sheet being the exact size required for three complete windshields, and carried by conveyors to the polishing machines. The sheets are mounted in quick-setting stucco to hold them firmly in position and passed on conveyor belts under a series of grinding and polishing machines. Sand mixed with water flows through a hole in the center of the cast-iron grinding disk and works its way out to the edge. Finer and finer sand is used as the glass moves on its way, each grinder taking a "cut," to use a machine shop expression. Eight grades of sand and six grades of garnet are used in the grinding. The plate is then washed and a smoothing disk removes all scratches. The glass then goes to the polishing disks which are felt-covered and use a mixture of iron rouge and water. At the end of the line the glass is turned over and proceeds back up the other grinding and polishing line, emerging completely ground and polished on both sides to the proper thickness. The glass is then cut to size and is boxed and shipped. It is recut to smaller size to fit the various frames at the assembly plants all over the world. The cutting is done with steel cutters and not diamonds. The glass plants are only another example of how the Ford Company has always attempted to supply all the basic materials which go into the manufacture of their cars. In the conventional system, the batch is melted in clay pots, each of which will contain enough glass to pour 300 square feet of rough plate glass one half inch thick. A furnace holds about 16 of these pots. When the glass is ready to pour, the pot is lifted out with a crane and carried to a casting table, where its contents are poured and rolled to the desired thickness. The plate is then sent through the lehr and annealed, coming out at a temperature cool enough to handle. The next step is grinding and polishing. This is done on circular decks on which the surface is completely covered by pieces of glass. The deck is then taken to the grinding machine and after being smoothed is sent to the polishing table where revolving felt blocks and fine rouge and water complete the process. In the continuous plan, the glass is made primarily of the proper thickness, thus saving one-third of the material and fuel necessary to melt it. In the old or cast process the glass must be made quite thick in order that it may be handled, and any waves in the large sheet must be removed by grinding. Cast glass is apt to sink in the lehr, so this sag has also to be ground out. When the Glassmere plant was taken over, about 30 percent of the output consisted of glass too thick, too small, or with defects. Under new management, with improved methods, the amount that has to be rejected for various reasons now runs between 5 and 10 percent.

Future Light

Although the Life and Work of Modern Man is Infinitely Better Lighted than it was in the Days of His Ancestors, We are Only at the Threshold of a Still Greater Expansion in Artificial Illumination

By M. LUCKIESH

Director, Lighting Research Laboratary, National Lamp Works of the General Electric Company

LIGHT is so essential to vision and, therefore, is so intimately associated with human activities that some interesting glimpses are possible into the economics of artificial light.

Where would civilization be without artificial light? Think of the multiplicity of modern activities which now depend largely—and many solely—upon it. For countless centuries it was crudely obtained by burning raw materials. With the advent of the electrical age a half-century ago, a great impetus was given to light-production. Now we have highly controllable light, relatively inexpensively obtained. This is exercising a great influence upon the economics of civilization.

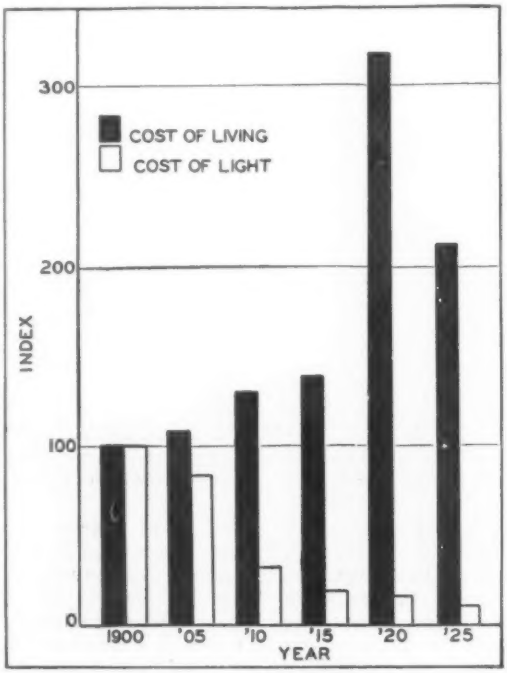
A COMMON laborer of today works about 10 minutes each day to pay for the lighting of his home by means of electricity. A half-century ago he would have had to work two and one-half hours to provide the same amount of light by means of gas flames. And if he had supplied himself a half-century ago with the same amount of light from candles he would have had to work 24 hours every day to pay his lighting bill. How the economics of lighting has changed! The humble candles of three-score years ago are now so expensive that only the wealthy could afford to use them for adequate lighting. For this great reduction in the cost of artificial lighting, modern science is responsible.

As the cost of artificial light decreases we can afford to use more and more of it. Science is proving that efficient and effective vision requires much larger quantities of artificial light than are now in use.

When man lighted a pine knot he dispelled darkness over a small area, but he had only started upon the problem of equaling average daylight conditions or, if possible, improving upon natural lighting. Darkness—mere light—more light—adequate light—these are milestones along the pathway of lighting development; and civilization has barely reached the first one. Vision evolved under natural lighting outdoors. The quantity, quality and distribution of daylight outdoors represent a desirable goal when serious visual work is involved.

A glimpse of the quantity of daylight convinces us that we are still in the age of *mere* artificial light. On a clear June day half the earth's surface is illuminated to an average intensity of at least 5000 foot-candles. The maximum intensity approaches 10,000 foot-candles or the equivalent of the illumination on a surface one foot from 10,000 candles theoretically concentrated into one source. Suppose the two billion persons on earth were distributed uniformly over its surface. Each person would occupy a 500-foot square. If present-day 1000-watt tungsten-filament lamps were used in reflectors hung at a reasonable distance above the earth, each 500-foot square would require more than one million lamps. In other words, each person would have to manufacture 25,000 lamps each day to compete with the sun in illuminating the earth's surface. These same persons would have to mine the coal and do all the incidental things that the electric service companies do to supply the energy to operate these lamps. Obviously, then, overlighting the earth or even a small part of it is economically impossible.

The candle-power of the sun is inconceivably great. If all the inhabitants of the earth were concentrated into one group and if each person were given one billion lamps of a billion candle-power each, the aggregate light-source would compete with the sun in luminous intensity. If the present rate of manufacture of light-sources were increased a billion times, it would still require a hundred million years to accumulate enough lamps for their combined candle-power to compete with that of the sun.



ONE UP, ONE DOWN

The high cost of living is being partly offset by the low cost of lighting—the latter went down, the former, up

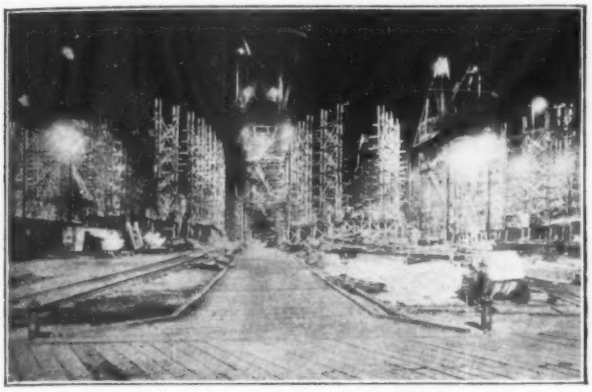
LET us view a few of the immediate economies possible at present. If good lighting to the extent of 20 foot-candles were put on the payroll of our industries and other work-places it would pay at least 500 percent in dividends. In other words, it is conservatively estimated that at least a 10 percent increase in production would result in excess of the increase in production necessary to pay the lighting bill.

Adequate and proper artificial lighting costs from one to three percent of the payroll. Measured in terms of manufacturing operations in this country at present, a 10 percent increase in production due to good lighting is equivalent to:

1,000,000 wage-earners;
1,000,000,000 dollars in wages;
2,500,000,000 dollars value added by manufacture;
6,250,000,000 dollars value manufactured products.

Besides these there are other tangible benefits such as decreased spoilage and greater safety.

All of us depend upon our vision to keep us safe from accidents. Danger always lurks in the shadows and in poorly illuminated places. In this country about four persons are accidentally injured every minute under conditions where poor lighting is a primary contributory cause. About two persons are accidentally killed each hour under the same conditions. Statisticians of insurance companies claim that improper and inadequate lighting is a primary cause in 20 percent of the industrial accidents. An average of 100,000 men are continually out of work owing to disability suffered primarily through defective lighting. Such a group could mine 100 times more coal than is necessary to supply good lighting to all the industrial workers in this country. If the economic loss is 1000 dollars per person annually we are losing 100 million dollars yearly by their idleness.



CONTINUOUS WORK, DAY AND NIGHT

With adequate illumination of the right kind, work can go on 24 hours of the day with little loss in speed due to the use of artificial lighting

THE DAYLIGHT LAMP IN A STORE

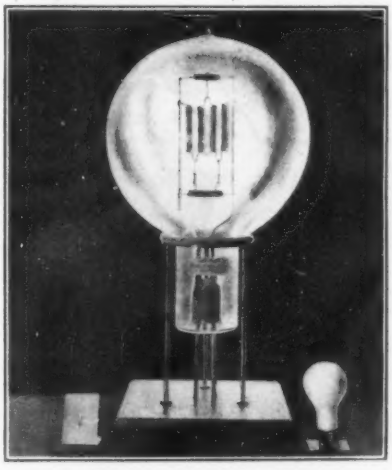
Colors may be matched under the illumination of these lamps, the unbalanced glow-lamp spectrum being corrected by means of filters

IN an elaborate analysis extending over 30 cities and including 3223 fatalities due to traffic accidents at night during 1923, it was concluded that 580 fatalities were due to insufficient illumination. The annual street-accident loss is stated by one statistician to be one billion dollars. Of this amount perhaps at least 100 million dollars is chargeable to faulty lighting. This is twice the yearly expenditure for street-lighting.

Studies of street crimes show that they decrease considerably when streets are well lighted. Ninety per-cent occur after dark and it has become an adage that "a street lamp is as good as a policeman."

In the conservation of vision we have a great source of profit from good lighting. Our usefulness is largely dependent upon vision. We need only note the large number of persons wearing glasses. More than half the adult population have defective vision. Is it not reasonable to suppose that the eyes should develop properly—as well as other organs—if used properly? This means adequate and proper lighting. The depreciation of vision due to faulty lighting costs us perhaps an average of hundreds of millions of dollars annually.

Then there are the very interesting and far-reaching psychological aspects of good lighting. Inadequate lighting is depressing in our work-places; and improper light—glaring and badly located light sources, improper reflectors, dirty lamps, et cetera—adds a harshness to the lighting and a general unkempt appearance, thereby contributing to the depressing effect. The economic loss due to such psychological influences is difficult to appraise, but it is none the less real and positive.



GIANT AND DWARF

Largest lamp uses 30,000 watts. Smallest (lower left) is the "grain-of-wheat" lamp. At right, a common 50-watt lamp

Excepting for the relatively few human clods, all of us react to our environment. A bright sunny day puts a spring into our actions and cheerfulness into our voice and thoughts. We work better. Few are conscious of such influences but also we are seldom conscious of the air we breathe. The efficiency of an average man on a dreary day as compared with that on a sunny day might be approximated at about 75 percent. Of course, men and women crave variety. We get tired of sunshine and like an occasional respite—a rainy day; but we prefer sunny days. Besides, if we have well-lighted homes, offices, factories, and streets, there will always be sufficient variety.

Besides this phase there is the specific stimulating effect of light. It is evident to a close observer in well-lighted places. In a certain laboratory investigation it was found that 8 percent more work—of a character done solely by touch—was accomplished when light entered the eyes through frosted spectacles than when the room was in darkness. This certainly was a measure of the stimulating effect of light—or conversely of the depressing effect of darkness—because vision was not involved in the work.

FROM these highlights it is seen that the substitution of adequate and proper lighting, for the improper and inadequate lighting which persists from yester-century, has a potential economic value amounting to billions of dollars annually. In fact, it is easy to compute enough gain to pay off the war-debt annually without a *net* cost to us of a single dollar. Good lighting makes us better producers with less effort. It has hygienic value. It decreases spoilage. It raises our spirits. It increases safety. It conserves vision. It can do much to keep up our standard of living and working as world competition becomes more severe. From almost every angle of our lives—because most of our activities and experiences depend upon the doorway of the visual sense, which in turn depends upon light—adequate and proper lighting can serve us much better.

Herbert Photo

ROAD TEST OF STEAM-POWERED CHASSIS

With a load of 11 tons, this bus chassis, equipped with Frank Curran's newly invented steam power plant, showed great economy in fuel consumption and negotiated with ease and speed all normal street grades. The inventor made these tests in New York City.

Will the Steam Automobile Return?

Success of Recent Tests Renews Interest in Steam as Motive Power for Automobiles

MANY times are the following questions propounded by those who cannot forego the admitted advantages of the steam automobile. Will steam ever come back? Will it ever be a real competitor of the internal-combustion gasoline engine in automotive vehicles?

About 1901 Stanley developed a successful steam automobile which was produced until a few years ago; this was one of the first practical automobiles. It was early proved that steam propulsion was flexible, smooth running, powerful, had a practically continuous torque and at that time produced a horsepower for a low weight of installation.

DOES it not, therefore, seem a curious fact that the steam automobile never attained wide production and that the few manufacturers since Stanley showed the way, have practically all disappeared from the market? It is not because it lacks advantages that steam has been left so far behind in the race. Rather it is a matter of certain disadvantages which heretofore have not been overcome.

Unquestionably the multiplicity of parts, the failures of flash boilers, the large amount of space occupied by the power plant, and the necessity of more than the average mechanical ability in its use and upkeep, together with the remarkable advance in the design and operation of gasoline engines, have been the reasons that have caused the steam automobile to be smothered.

There has recently been tested in New York City traffic, a steam bus which has been so successful that the old questions of the relative value of steam and gasoline propulsion have been revived with considerable pertinency. Our illustrations show the general appearance of the bus chassis and the diagram shows the location of the several units.

Steam of 600 pounds per square inch pressure is generated in a seamless, welded boiler of entirely new construction, the upper part being of the fire-tube type, while the lower part is of water-tube design, the roll of the tubes being welded to the boiler head. Between the above two parts is placed the first superheater. Steam is drawn through this to the throttle, which is operated by foot, from whence it passes to the second superheater which forms the lining of the burner, and is then delivered to the engine.

Courtesy Cruban Machine and Steel Corp.

UNDER THE HOOD

Accessibility of equipment may be seen from this photo. Sturdiness and simplicity appear to have been considered in this design

TWELVE independent water coils all feed a common reservoir and they are arranged so that should one coil prove defective it can be cut out by merely turning a valve. The boiler weighs 400 pounds and delivers 185 horsepower. It is the invention of Frank J. Curran.

Courtesy Cruban Machine and Steel Corp.

MAIN BURNER, VAPORIZER

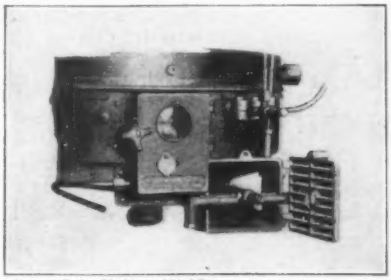
This burner and specially designed pilot light burn fuel oil, kerosene, or gasoline

A vaporizing type of burner is used with a specially designed pilot light, both of which burn any grade of fuel oil, kerosene or gasoline, between 23 and 65 gravity without change of adjustments. A steam bus, with 11 tons load was driven over various grades in the outskirts of the city, averaging better than eight miles per gallon.

THE engine is of the three-cylinder reciprocating, simple, uniflow type with improved valve action which regulates cutoffs from full stroke to five percent. Tests show that one horsepower is developed for every 22 pounds of steam consumed. The arrangement of the auxiliary controls is such that by closing all valves, the throttle, automatic by-pass, steam gage, thermo-couple water level indicator and safety valve can be removed for repairs.

Reference to the diagram will show how neatly this engine takes the place of the usual clutch and gear housing in the gas automobile, and how compact and clean is the design. The exhaust steam enters a radiator or condensing system from which the water returns to a reserve tank. From this tank a small positive-feed pump supplies the boiler again as needed, the water level being controlled by an automatic regulator.

An ingenious hand pump makes it possible to operate the contributory devices to the boiler and burner by hand instantly at any time the automatic devices should fail. The throttle has an automatic by-pass or cylinder relief; when the throttle is closed the pressure in the steam chest and cylinder is immediately by-passed to the condenser.



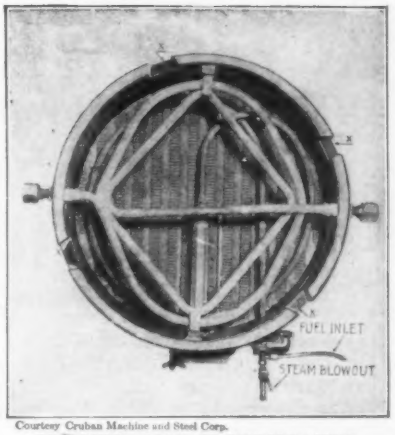
Courtesy Cruban Machine and Steel Corp.

SIDE OF BURNER

Through the open main burner door may be seen the single nozzle and air intake tube

The engine becomes dead as soon as the foot-pedal throttle is released and itself acts as a brake when desired, thus relieving the wheel brakes when stopping. Many of these features described are the invention of Charles R. Nebelmesser.

The main drawbacks in the past to the adaptation of steam to vehicles, have been the limits of space available, and the weight allowable for horsepower output for large installations.



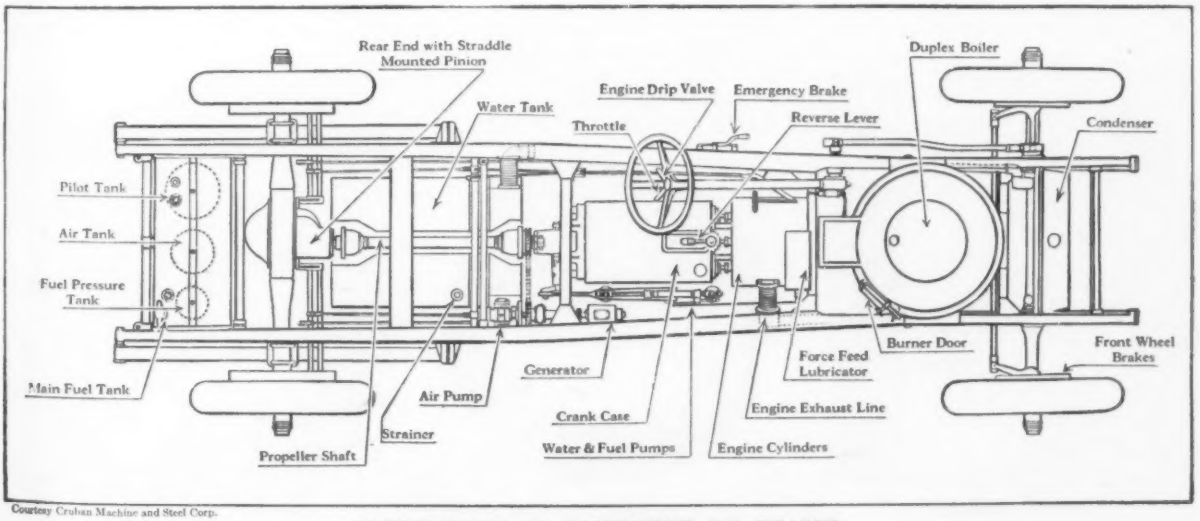
Courtesy Cruban Machine and Steel Corp.

BURNER AND SUPERHEATER

Superheated steam passes to throttle, thence through the second superheater to the engine

These, it would seem, have been overcome to a large extent in the steam engine which we have described. Whether or not this portends a new development or revival, or whether it is in the end only a particularly good demonstration of an individual machine, time and future experiment alone will tell. But in the search for economical and flexible operation the automotive industry may well pause to give a more than passing inquiry along this line.

TO the average person who must frequent streets which are crowded with traffic, the elimination, at least in part, of some of the obnoxious gases which are the products of combustion in the gasoline engine, will be welcomed as a wholesome boon, for clean air to breathe is rapidly becoming at a premium and no one realizes it more than he who must inhale, almost without cessation, the atmosphere which now is a part of his daily experience.



Courtesy Cruban Machine and Steel Corp.

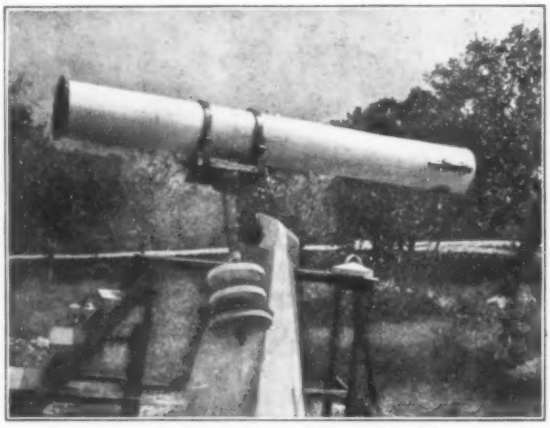
DISTRIBUTION OF EQUIPMENT ON CHASSIS

This view gives an idea of the compactness of Mr. Curran's design in which the parts are not crowded as is usually the case on gasoline cars. Ease of operation, efficient functioning of parts, and cost of upkeep were considerations in the design and location of parts.

Tropical Telescope Making

A Professional Astronomer on the Island of Jamaica Takes Up An Amateur Art Fostered by the Scientific American

FROM Prof. George H. Hamilton of "Iona," Mandeville, Jamaica, British West Indies, the telescope editor has received an interesting communication describing two telescopes recently made with the aid of the SCIENTIFIC AMERICAN book, "Amateur Telescope Making." Prof. Hamilton formerly directed the department of astronomy at Bellevue College, Nebraska. Later he devoted five years to research on Mars at the famous Lowell Observatory in Arizona and until recently, when he assumed charge of his own research in Jamaica, he was a member of the staff of the Jamaica Branch of the Harvard College Observatory, directed by Prof. W.H. Pickering. He is a member of the American Astronomical Society, the Royal Astronomical Society, and the Société Astronomique de France. He is the author of "Mars at its Nearest." Prof. Hamilton's communication follows:



THE EIGHT-INCH TELESCOPE

Largely made from Ford axles and axle housings, brake drums serving for setting circles as if made for that very purpose

"MANY months ago the SCIENTIFIC AMERICAN wrote to Professor W. H. Pickering, requesting that I should tell how I had got on with my telescope which I was making with the aid of 'Amateur Telescope Making.'

"I send you photographs of the instrument, any one or more of which you may choose for publication; also a photograph of the Moon taken with the 12-inch mirror which I later mounted in the same tube in which the eight-inch mirror had been mounted.

"You will notice that I have not attempted to go beyond the well-known design of Mr. Clarendon Ions, which involves the use of Ford parts. I was more concerned in getting an instrument that could be used for the recent opposition of Mars than in attempting to improve or change the design in any way.

"My method of grinding and figuring the eight-inch mirror was the same as that described in 'Amateur Telescope Making'—and thereby hangs a tale. Owing to tropical conditions in Jamaica, I had difficulty in keeping my pitch lap in shape. The cellar in which I worked never went below 69 degrees Fahrenheit, although it never went above 74 degrees, so my lap would start flowing over night, or while testing. Not only would it exude from between the tool and mirror if cold pressed for more than 15 minutes at a time, but it would persist in closing up the channels and forming a solid tool.

"I found out something from this, however. In recutting the squares, I found that they would often come off whole from the tool. This disconcerted me until I found that with care they could be replaced without detriment to the figure. In this way the bug-bear of remaking the tool every time one wished to omit squares for figuring was dispensed with—the same tool being made and remade with impunity.

"When the work on the eight-inch mirror was stopped, it still had a slight zone, but as I found I could get good definition with it, I silvered it and made 45 drawings of Mars while I was grinding a 12-inch mirror. This 12-inch one is now mounted in place of the smaller mirror; it has exceedingly good definition and makes an altogether better instrument.

"I soon found in polishing my 12-inch mirror that with the heavy full-sized tool (one and one-half inches thick) there was no hope of keeping the squares on the lap. Whether I had them on the tool or not, the tendency was to make the curve on the mirror a marked hyperbola from the start.

"It was then that I ceased to follow 'Amateur Telescope Making,' at least in regard to polishing, and fell back

WITH ITS MAKER

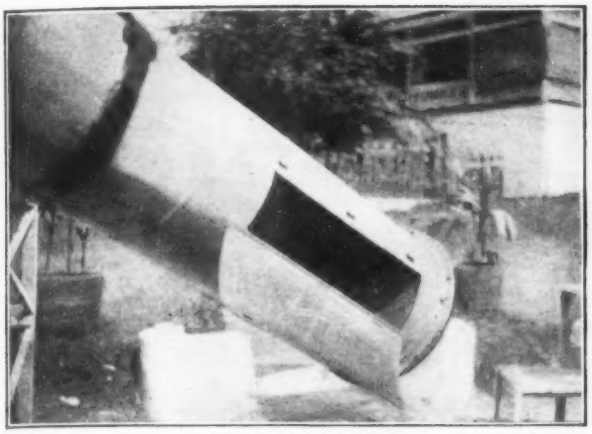
The telescope is located on a high plateau fifteen miles from the seacoast of Jamaica

TROPICAL MOON

This photograph was taken with the same telescope, equipped with a 12-inch mirror

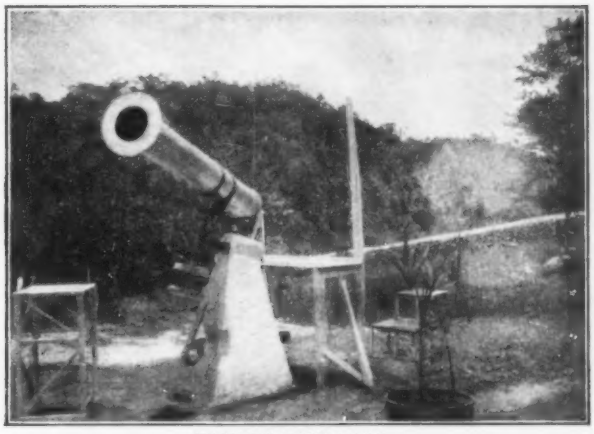
READY FOR MARS

In low latitudes more is seen on Mars than in the north—less air to see through



LOOKING WITHIN

Through the hinged door the 12-inch mirror shows. It may easily be removed from the telescope when the observation is finished, preventing the silver from tarnishing



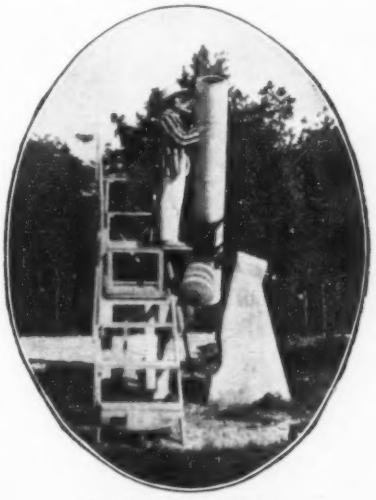
THE DIAPHRAGM

The 12-inch telescope was equipped with an iris diaphragm like those on cameras. This shows to better advantage in the picture in the lower left-hand corner of the page

on what I knew Professor G. W. Ritchey did in polishing his mirrors, for I had watched him polish the 100-inch mirror of the telescope at Mount Wilson Observatory, as well as mirrors in the Paris Observatory. His written descriptions also came in handy, as did those of Draper. I had, of course, seen the small tools used by Ritchey, for taking out zones; but these were elaborate in their make and shape and were for very large mirrors.

"IN abandoning the full-sized 12-inch tool, I used a pitch lap three and a half inches in diameter. I turned my 12-inch mirror face up, and soon was able with various symmetrical strokes to bring the figure nearly correct. The tool was a little too small to finish with, as it needed a slightly greater area in order to create a uniform curve. This I obtained with another tool having a diameter of five and a half inches, or just under the semi-diameter of the mirror. With this tool, which also had no channels, I completed the mirror.

"In designing my mounting and the tube, I made them of such a size that the 12-inch mirror could be placed in the tube if the focal lengths of the two mirrors were approximately the same. Since I do not believe in short focus instruments where the magnification is reached through high-powered eye-pieces, I gave my eight-inch mirror a nine-foot



OBSERVING CHAIR

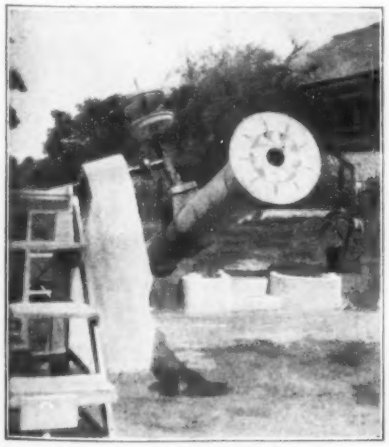
This three-part, knock-down structure has an overhanging step, facilitating observation from otherwise awkward positions

seven and one-half inch focal length—a focal ratio of nearly f/15. My 12-inch mirror has a focal length of nine feet, ten inches, so with only slight adjustment it was easily placed in the tube in place of the eight-inch mirror of two and one half inches shorter focal length.

"The eye-piece test at the center of curvature is to me one of the most interesting, but no one gives exhaustive information on it. The out-of-focus images, both inside and out, we are told by Draper, should be uniform disks, identical on both sides of the focus, if the mirror is spherical. Now the Rev. Mr. William F. A. Ellison leads one to infer as much, but Mr. E. Denton Sherlock in *English and Amateur Mechanics* of August 20, 1926, presents drawings composed of concentric rings, not uniform disks.

"SO far, it has been my experience that the images formed by the eye-piece are, in a sense, replicas of the surface of the mirror as seen under the knife-edge test; that they show concentric and uniformly circular light and dark zones where zones are seen in the shadow test and under a supposedly oblique illumination.

"At present I am busily engaged in surfacing the back of a 21-inch Saint-Gobain glass disk—this, to bring the thickness of the disk to as near uniformity as possible. The front surface I have already ground to within one foot of the focus I wish it to have. For this mirror I am using a 12-inch tool as my largest size."



STOPPED DOWN

The iris diaphragm may be closed when there is too strong a light, as from the Moon

ANOTHER VIEW

The low angle of the polar axis is due to observer's low latitude—only 18 degrees

REMOVING THE CORK

Native Algerians removing large sections of valuable bark from the trunk of a cork tree

COLLECTING THE SLABS OF CORK

A cork depot by the roadside in a cork forest in the Algerian province of Constantine. Here the cork bark in its crude natural form is collected for transportation

NATIVE TRANSPORTATION

The cork is carried by natives in the primitive manner shown from the depots in the forests to the nearest convenient shipping point

PACKING THE CORK

The slabs of bark are cut into squares and pressed as shown. The cork is then tied into bundles for shipment to foreign countries

The Origin of Cork Products

THE little cork that excludes the air from your bottle of medicine once grew on a tree! True enough, it was not then in the same shape that it is now, nor did its original shape resemble in any way the symmetrical little guardian of the bottle that it is today, but nevertheless, its birthplace was the trunk of a tree somewhere in a far-off land. In Algeria in particular is the gathering of the bark of the cork tree an important industry. Here it has been exploited to a great extent by the French, with the result that the growth and replacement of the cork forests has been placed on a scientific basis. Large tracts of land have been planted, and it takes 12 years from the time of planting for the trees to reach maturity, when the bark can be removed. After this has been done, as shown in the illustrations reproduced above, three years at least must elapse before another crop can be gathered from the same trees. Even then the bark will not be as thick as it should be, and so it has been found advisable to allow six years to pass before the second crop is harvested. Aside from the slow growth of the cork tree, cultivators have found another trouble in the form of parasites of various kinds that attack all parts of the cork tree. However, experiments have been carried out which promise speedy relief from these pests, and, in fact, the results so far obtained have been shown in an increased yield of 50 percent. Cork has many uses aside from bottle stoppers, one unusual and important one being the making of a black ink from the impalpable dust that results when cork is calcined. The bark is being utilized for making life-preservers and similar safety appliances, linoleum, toilet articles of various kinds, inner soles for shoes, and so forth. Research by French scientists has shown that cork can be subjected to the action of various chemicals without changing its composition. Many useful substances, among them being tannin, gallic acid, gums and oils can be extracted from the bark of that valuable native of Algerian forests, the cork tree.

The Red Hill Artifacts

New Archeological Discoveries Made in Texas by a Scientific American Reader Point to the Recently Revived Query: "How Ancient Is Man in America?"

By DR. CYRUS N. RAY

THE article in the August, 1927, issue of the SCIENTIFIC AMERICAN referring to the prehistoric remains at Frederick, Oklahoma, has given information which encourages me in a long contemplated effort to draw the attention of the scientific authorities to some finds of my own in this region. Prior to reading that article I had hesitated to do so because of the generally held belief that man did not exist as a contemporary of the mammoth in America.

In the locality of Abilene, Texas, there is a chain of gravel hills or ridges, extending across the country, doubtless the vestiges of an ancient river bed. The structure and conformation of these are the same as the gravel hill at Frederick.

While the hill at Frederick is more than 200 miles north of here, it was my privilege many years ago to climb all over it and thus I became quite familiar with the type of gravel and conglomerate stone found there. Exactly the same formation exists here. Remains of mammoths and other faunal life of that period have also been found in the gravel beds here.

Flint arrow heads are occasionally found on the surface in this section but are not so abundant as they are farther east, and those found represent about the same state of cultural advance as those found farther east.

However, at various times extending over a number of years, I have picked up flint artifacts on what is known as the Red Hill, nine miles south of Abilene. These have been found in the loose gravel either at the top, sides, or at the bottoms of deep gully washes in this hill. The workmanship of all but one of them has been crude and primitive and somewhat comparable to those represented as belonging to the most ancient French cave deposits. I have had a photograph made of the objects with some more modern arrow heads found on the surface of the ground, on what is evidently an old camp ground near a spring in the south part of the county.

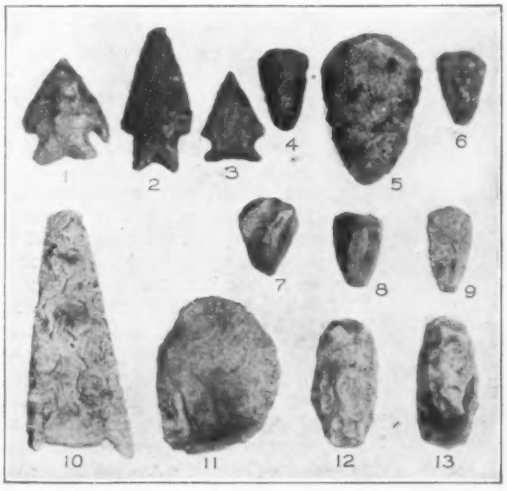
I HAVE also included six hide-dressing scrapers which were taken from mounds at Miami, Missouri, for comparison with the two found on the Red Hill. Numbers 1, 2 and 3 (below) are the arrows from the camp ground; 4, 5, 6, 7, 8 and 9 are the Missouri mound-builder hide-dressing tools. These have a slightly curved smooth bottom surface and a finely chipped convex back, with a sharp cutting edge at the top or broader end.

The five smaller ones are skilfully fashioned to fit between the palmar surfaces of the thumb and index fingers. Below these are 12 and 13, the much more primitive type of hide scrapers found on the top of Red Hill. Number 11 is evidently an irregular primitive attempt at arrow making. This was found in loose gravel half way down the side of the Red Hill. Number

THE AUTHOR

Dr. Ray is also an amateur plant breeder. Picture shows the "rayberry," a successful cross between the loganberry and nessberry

10 was found at the bottom of a deep gulley wash in the side of the hill. It is of extra fine workmanship, sharp, with thin edges, and the tooling is so fine that fracture marks are hardly discernible. In fact, this lance head is of smoother workmanship than most of the arrow heads that I have seen. Although found on the same hill, it could hardly belong to the same geological epoch—it must have been made by a very recent Indian. Numbers 12 and 13 were found on the south of the hill, a half mile north of this 10 was found. Number 11 was found a mile north of 12 and 13.



DISCOVERIES

Each artifact is described in the text. These discoveries came about as a direct result of the publication, in the SCIENTIFIC AMERICAN, *August, 1926, of an article entitled "New Trails of Ancient Man," by Harold J. Cook. In the latter article Mr. Cook told of certain discoveries made at Frederick, Oklahoma, by Dr. F. G. Priestley and reported, shortly previously, to the* SCIENTIFIC AMERICAN. *There are doubtless many extremely valuable discoveries waiting to be made in this country, but when it comes to making them there are not enough scientists to go around. General readers are therefore requested to keep an eye on excavations in their communities*

¶ *How hidebound prejudice can block progress in science is illustrated by the fact that the author of the accompanying article did not for a long time report his finds because he believed it futile. Certain anthropologists have so often denied that man can possibly have been long in America that the idea has taken root in the popular mind that they are prejudiced.*—The Editor.

Meurisse Photo

UPPER STATION

Here, amid eternal snows in an atmosphere of vaporous clouds one may debark fresh, and eager to wander over the rocky summit

Meurisse Photo

GOING UP

Much safer, it would seem, to travel this way than by foot over rocky soil with jagged stones constantly turning under-foot

"Mountain Climbing" by Air Cable

A New Enterprise Affords Access to High Regions With None of the Accompanying Hardships of a Treacherous Ascent

A MOST attractive example of the use of modern engineering is the new Mount Blanc cableway, which marks a new departure in the way of mountain excursions.

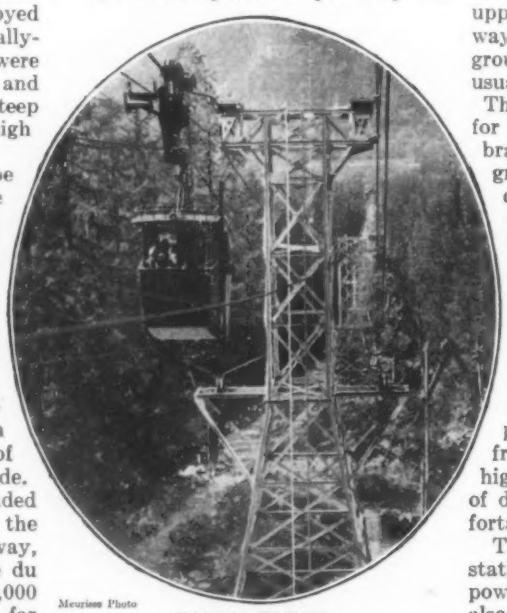
The cable line up the mountain slope of Mount Blanc now takes passengers up to points which were unattainable by the usual tourist, and affords a wonderful prospect over the field of mountain peaks and glaciers which heretofore had been enjoyed only by the few bold, specially-equipped, mountain climbers who were willing to undertake the hazards and fatigue of an ascension up the steep slopes in order to reach such high altitudes.

No special dress or outfit will be needed as before to reach these elevated regions as tourists in their ordinary clothes can step into the comfortable cars and be carried up the lofty heights of the mountain.

The section of the cableway which was recently put in service, starts from a point in the neighborhood of Chamonix, passes before the Dard Cascade and rises upon Mount Blanc as far as the station of La Para at some 6000 feet altitude. At a later date, the line will be extended farther up the mountain, passing the Glaciers and the Col du Midi on its way, and reaching the peak of Aiguille du Midi, at an altitude of about 13,000 feet. It is expected to ascend as far as the Glaciers next year, and the rest of the construction will soon follow.

The cars containing 18 passengers are suspended from an overhead cable by means of a roller carriage which travels on a steel cable in the way of a track. The carrying or track cable is stretched between high structural steel towers. Our photographs show the construction of the towers. They are planted in concrete foundations, so that they can be erected on very irregular ground.

The cable system is probably the most elaborate one yet employed. At the top of the set of lines is the heavy carrying cable which supports the roller carriage from which the car is suspended. The carriage is mounted upon eight wheels. Below the carrying cable is the hauling cable which operates in the same manner as an endless belt; that is, it proceeds upward from the Chamonix ground station upon pulleys provided on the towers, passes around a drum at the upper station at the end of the cableway line and returns again to the ground station, where it is driven as usual by a drum.



Meurisse Photo

CABLE TOWER

Along an air-avenue, the car ascends from verdure-covered valleys to snow-clad peaks

The system further contains a cable for emergency use and also for braking purposes, which can be gripped at all times by a jaw type of brake, so that there will be no danger that the car will run backwards. If need be, this cable can be used to replace the hauling cable. Another cable passes alongside the car and runs upon pulleys mounted on the car itself. The object is to steady the car and to prevent all excessive swinging, as might happen if the car were left hanging free in the air, and especially in a high wind. This would be a source of danger, and would also be uncomfortable for the passengers.

The cable drum at the Chamonix station is operated by a 100-horsepower electric motor, and the station also contains a second electric motor which serves as a standby, as well as a gasoline engine for emergency use.

"Pay-As-You-Use-It"

Automatic Metering of Telephone Calls Proves Equable Method of Computing Charges

By CHARLES F. A. MANN

ONE of the most revolutionary improvements to increase the usefulness and lower the cost of our far reaching telephone service is now in operation on the telephone system of Everett, Washington—that of metering the telephone service at so much per call instead of the old flat rates.

The invention of the metering device dates back several years. Charles M. Beattie, treasurer of the Rochester, (New York) Telephone Company, evolved the idea of regulating the subscriber's home meter by an automatic time-clock arrangement installed in the central office and operative only when the subscriber called. It was finally carried to a successful completion by Mr. Garrison Babcock of Seattle, Washington, who later organized the American Telechronometer Company.

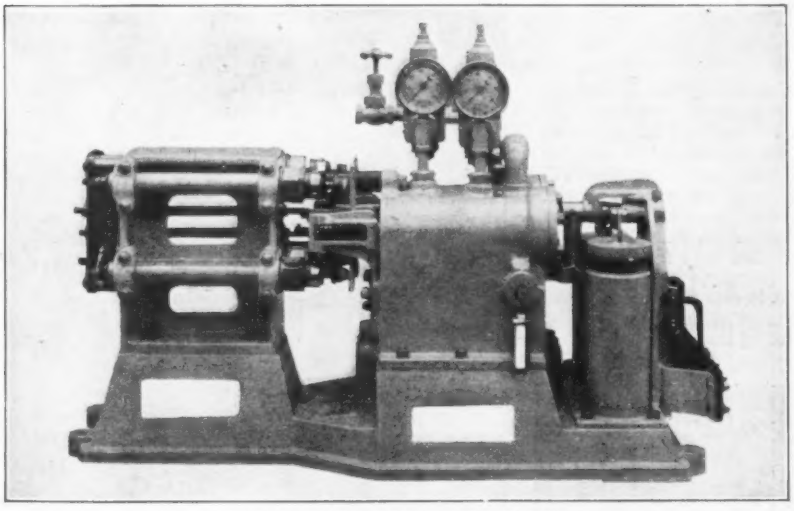
The basic principle of the system used for metering the telephone service in units of time is the change of polarity of the current used to operate the telephone, by means of a compressed-air operated set of carbon-pile rheostats forming one side of a Wheatstone bridge circuit. An electrically operated time-clock operates through a pair of solenoids, which control the admission of air to the cylinders of the rheostats, or "pole changer," as the device is known.

In working out the details of this device, a unit of measure had to be evolved for basing the rates to users. This unit is known as a "telechrone," a unit of conversation being one minute in length. The operation of the system is as follows:

WHEN Mr. Subscriber lifts the receiver to call a number, the operator gives him the right connection and at the same time plugs in the pole changer through the circuit. This pole changer changes the polarity of the current flowing through the circuit every 15 seconds and upon each change, the polarized motor magnet in the meter, located in the subscriber's home, moves backward or forward. Each movement of the magnet represents one unit of measure known as a "telo" or one fourth telechrone. Thus the magnet in the subscriber's meter is absolutely correct in its cycle of time because it cannot move unless the polarity is changed and this is directly controlled by the master clock in the exchange. The magnet is connected to a ratchet wheel and moves it one notch every 15 seconds. The telos and telechrones are registered on the three dials on the front of the meter, just as on water or gas meters. When the call is completed, the connection is broken and the meter stops. The device is noiseless in operation and can be used in automatic telephone systems, provided the transmission lines can be divided with suitable relays.

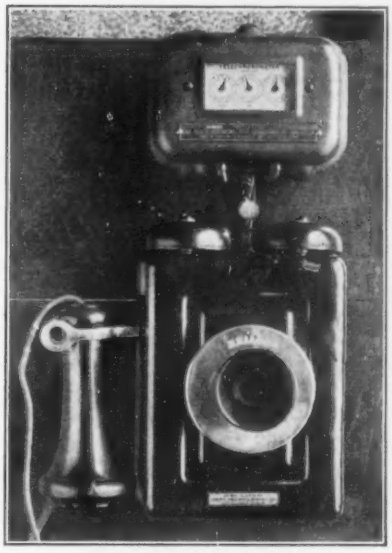
The rates begin with a minimum monthly charge of three dollars for one-party lines with a charge of nine mills per telechrone, going down to three mills for all used above 1000. Other rates go down to a minimum charge of 50 cents per month and the same charge per telechrone for ten-party lines. The actual amount earned was slightly less than under the flat rate scale but the small subscribers' rates were cut in half, and the larger user shared more equally with the little user than ever before. A special contact drum on the master clock reduces the rates one half between the hours of eight P. M. and eight A. M. by lengthening the telechrone to two full minutes and the telo to 30 seconds instead of 15.

At first this system produced 2000 dollars less revenue per month but it was pointed out that some 1200 new subscribers were ready to take advantage of the new low rates which would more than make up this loss. This means that the average family who could not ordinarily afford telephone service may now have it within their reach and estimates of five calls per day are a big average in small families, which would bring them telephone service at about $1.50 per month instead of three or four.



WHERE THE TIME IS MEASURED

This is the pole changer, described in the text, which controls the meters located at the telephones. On the left are the carbon rheostats and on the right are the solenoids which control the air



THE "WATCHDOG"

The meter, shown here with a wall type 'phone, is also made for measuring time with all other kinds of telephones

Inventions New and Interesting

Old "Mother Necessity" Provides Us With Aids to Accuracy, Speed, and Comfort in Many Fields

CONDUCTED BY ALBERT A. HOPKINS

RESTFUL COPY GUIDE

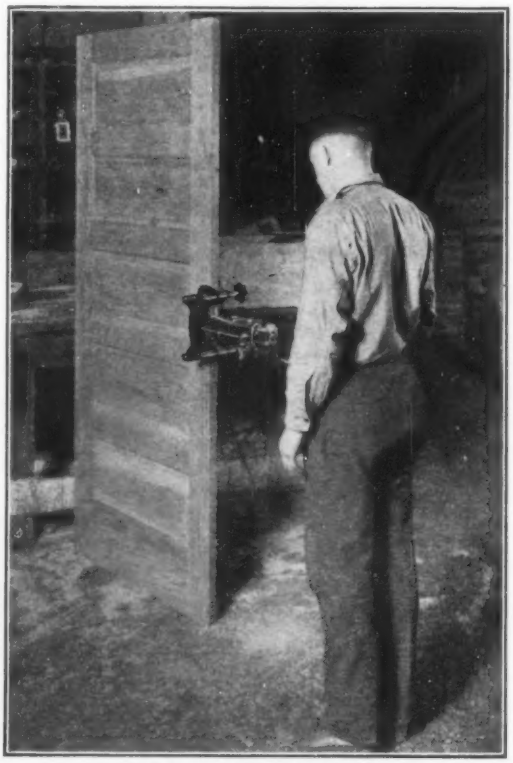
This device consists of a piece of one fourth inch plate glass attached by a silk ribbon to a counterweight. The lower half of the glass is coated a transparent green so that while acting as a guide line it does not hide any corrections or notes that may be below the line

BIRD BATH AND SPRINKLER

Combining the utilitarian purpose of wetting the lawn with the humanitarian one of furnishing a bath for birds, this sprinkler will appeal to many people. After the water has been turned off, a supply remains in the bowl for the use of our dusty, feathered friends. It is cast in one piece and has no moving parts to get out of order or to be adjusted. It can be moved without damage to shrubbery by pulling the hose

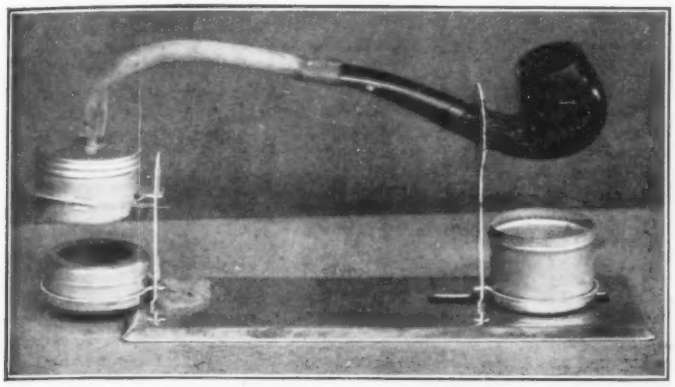
EMERGENCY RAIN COVERS

It is unnecessary to carry a troublesome umbrella when rain threatens if one has a treated paper "rain-pak" handy. Can be carried in the pocket



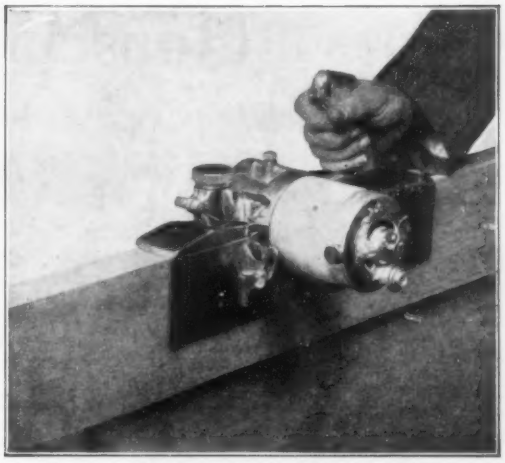
DOOR LOCK MORTISER

Attached to a door by merely tightening two handles, this electrically operated machine cuts an average mortise in 40 seconds with great accuracy, thus doing away with the tedious old hand method of hammer and chisel. The motor feeds automatically by merely moving handle up and down. The photograph shows simple operation



STEAM PIPE CLEANER

You'll find your pipe much sweeter, and "friend wife" will not object to its aroma after it has been cleaned by steam. This cleaner consists of a stand, an alcohol burner, a water boiler, and a rubber tube. Steam cleans nicotine and other matter from stem and bowl

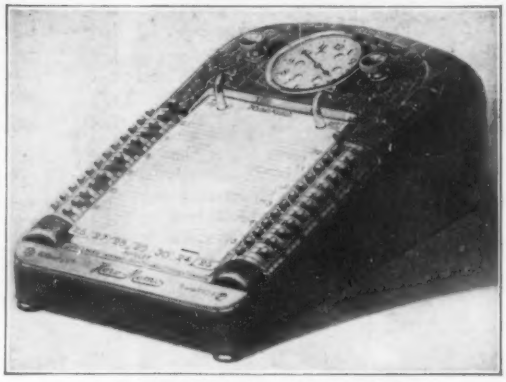


ELECTRIC HAND PLANE

For speeding work, promoting greater efficiency and accuracy, and for relieving the workman of fatigue, this plane comes as a boon to the man with much timber-edge planing. The motor is controlled by pressing a button on the handle

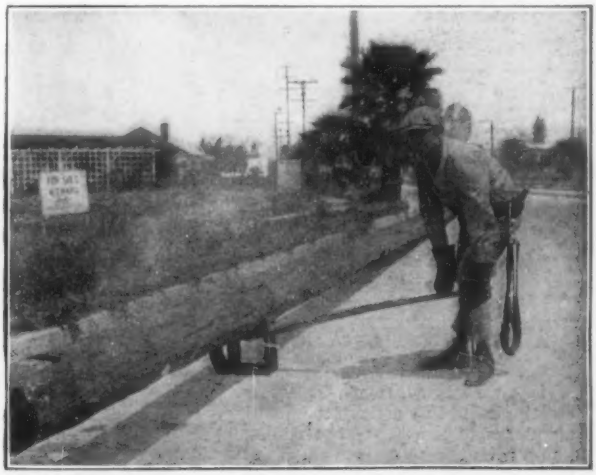
FAULT FINDER

A tool for testing and locating broken places in insulated electric wiring consists of a pair of pliers, to one jaw of which sharp, heavy needles are attached. By pressing into the insulation as shown in photograph, the needles touch the wire and, at point of break, straddle the space, causing lights to burn again. Jaws are insulated



APPOINTMENT ALARM CLOCK

Make a note of appointments, or things to be done, on the memorandum pad illustrated above, set the contacts opposite the proper spaces, and a bell and red signal will remind you of them at the correct time. It may be set for each quarter hour and automatically eliminates forgetfulness



ONE-MAN POLE END LIFTER

To lift a telegraph pole in order to cut gains and roof, and attach cross arms, five or six men are required when it is done the old way. The photographs show how easy it is for one man to lift a heavy pole with this new invention

Household Inventions

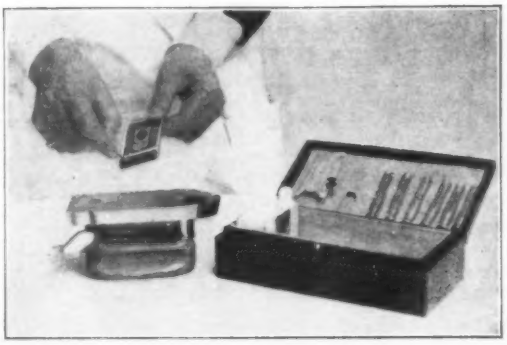
Interesting New Devices That Are Both Useful and Time Saving to the Modern Housewife

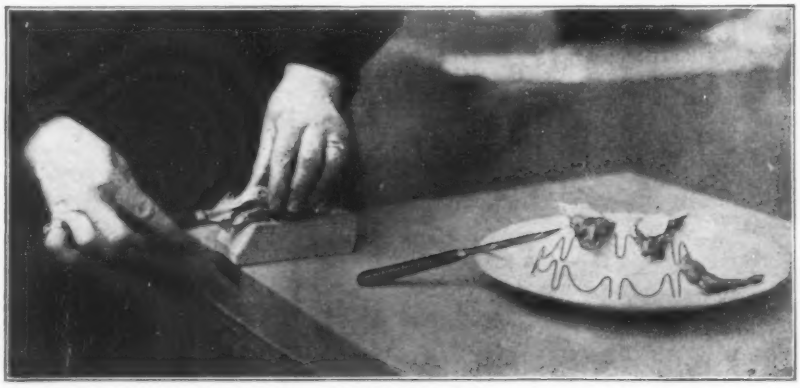
WASHING BENCH

A time and step saver that will appeal to the average woman is the folding wooden bench illustrated above. It can accommodate a washing machine as well as three tubs in a convenient manner. When not in use the bench can be folded compactly and put away out of sight

LAUNDRY KIT

Neither electricity, gas, or other ordinary heating method is needed with the new ironing equipment shown at the right. The illustration shows a fuel receiver with a small block of solidified alcohol ready to be lighted. The heat is intense and the iron heats quickly. All the necessary articles, including clothes pins and line, are provided in the outfit, ready for emergency use





OYSTER RACK

It has always been more or less of a problem to arrange oysters neatly on a plate. From France now comes this wire rack to set on the plate and hold the shells in order. An oyster opener having a flange attached to each side of the blade for separating the shells is also shown in the photograph

A HANDY COMBINATION

With this combined cork and sprayer it is unnecessary, when spraying clothing and other articles to eliminate moths, to pour the moth repelling liquid from the bottle into the usual hand-operated sprayer used for this purpose. In the cork is a plunger pump, and a few strokes up and down sends out a fine spray of the liquid

FRUIT-JAR GRIP

With this lifter, fruit-jars can be lifted from boiling water without the slightest danger of burning the hands or fear of dropping the fragile jars

ELECTRIC EGG BOILER

Cooks your eggs on the breakfast table while you are eating your fruit and cereal. Put in the egg and a teaspoon of water, cover with an ordinary drinking glass and when the steam stops the egg is cooked just the way you want it. The amount of water times the cooking; one teaspoon for soft boiled and two for medium

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

CONDUCTED BY ALBERT G. INGALLS

Roller Bearings End Jerking to Start Trains

AS everyone knows it is much easier to pull a load over a highway on a wheeled vehicle than it is on a sled, for the reason that a rolling contact offers far less friction than a sliding contact between vehicle and road.

For many years past, attempts have been made to produce a roller bearing for trains that would stand up under the heavy duty imposed and would meet the severe vertical and side stresses to which all train axle bearings are subjected. After long and costly experiments in the laboratory, and with actual railroad cars, the Timken Roller Bearing Company has produced a bearing which has proved so satisfactory that the Chicago, Milwaukee and St. Paul Railroad have completely equipped two of their crack overland trains, the *New Pioneer Limited*, and the *New Olympian*, with these bearings. These are now in service and giving complete satisfaction.

The bearing consists of an inner raceway carried on the axle, two sets of tapered rolls carried in two gages or separators, and two outer races. The inner race or cone which is formed in one piece, has ribs at the outer ends and tapers upwardly to a rib in the center. The upper raceway consists of two separate cones. A 5 inch by 9 inch axle has a bearing of the following dimensions: Bore 5 inches; outside diameter 11⅝ inches; and width of cone at its contact with the axle 6¼ inches. The capacity of such a bearing is 28,900 pounds vertical and 23,275 pounds thrust load, at 750 revolutions per minute which, with 36-inch wheels, corresponds to 80 miles per hour.

The many tests which have been carried out show that at all speeds below 36.5 miles per hour the resistance due to plain bearings is very much greater than that due to roller bearings.

The first tests to determine the comparative starting acceleration, running, and coasting results, were made with two standard railway freight cars, one equipped with tapered roller bearings and the other with plain bearings. With the exception of the bearings, the two cars were identical in every respect, and the car with roller bearings had made 22,100 miles in main line service. Cars were loaded to capacity with steel billets and the total weight in each case, of car and load, was practically the same.

Other things being equal, the efficiency of a train bearing depends upon the lubrication, and when a car with plain bearings is running, a thin film of oil between the axle and bearing gives the desired reduction of friction; but when a car is stopped, the vertical load squeezes this film out and there is close contact between bearing and axle, with a consequent temporary loss of lubrication; hence considerable force is needed to start the car and move it, until the film of oil is re-established.

In the test above referred to, the starting resistance was 8.8 to one in favor of the roller-bearing car; that is to say, there was a saving in starting of 88.8 percent.

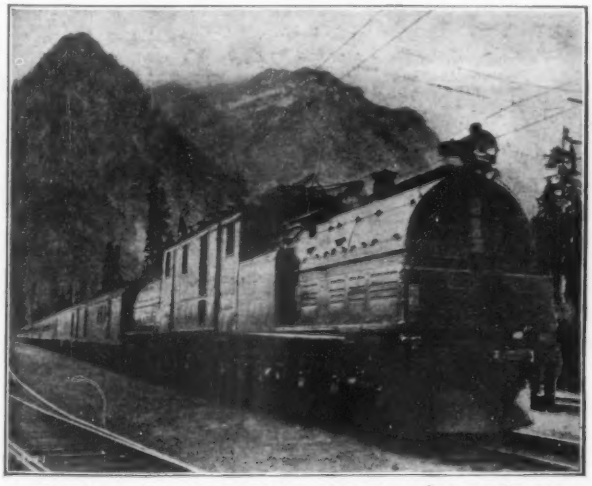
In the acceleration test, each car in turn was hauled by a 300-horsepower electric baggage car for a run of 20 seconds. The average acceleration per second, for 15 seconds measured in miles per hour, was .69 for the roller bearings and .57 for the plain bearing car. After 20 seconds the speed was 10.54 miles per hour for the roller bearing car and 8.75 miles per hour for the plain bearing car. The direct power saving during the 20-second run ranged from 28 percent for the first five seconds to 18 percent in 20 seconds.

In a test to determine the saving in power consumption made over 28.30 miles of track, there was indicated a power saving of 17.4 percent in favor of the roller bearing car.

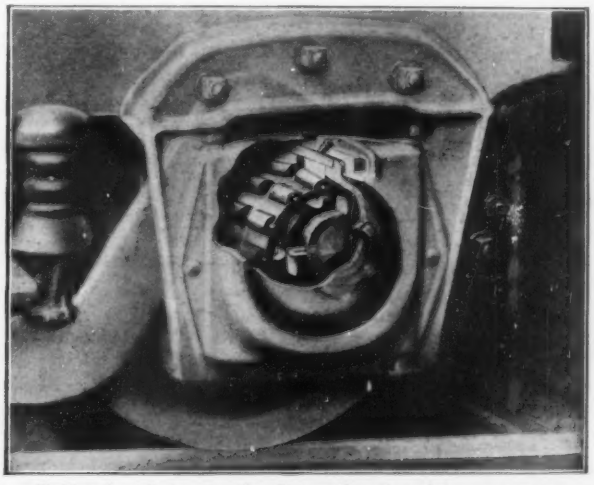
In a coasting test on a down grade at the starting point of 0.25 percent, the roller bearing car started without assistance when the brakes were released, whereas it was necessary to bump the plain bearing car with a locomotive more than once before it would start. The roller bearing car coasted for 7200 feet and the plain bearing car for 1300 feet. In a test with two gas-electric trains of the same weight, one with roller bearings and the other with plain bearings, over a stretch of some 200 miles, it was found, in a total of 26 tests, that the over-all power saving of the roller-bearing train amounted to over 9 percent on a gross ton-mile basis.

Hot boxes are a frequent cause of delay and, incidentally, of expense. One road estimated that in passenger service a hot box costs about 30 dollars. Roller bearings have practically eliminated this troublesome situation. There is an advantage also in the matter of lubrication. It is found that grease is the best lubricant for roller bearings, as against the oil used in plain bearings. Experience has shown that the grease used in roller bearings lasts much longer and costs less for renewal than the oil lubricant for plain bearings. There is a saving of waste and of labor in packing it in the bearings. A check-up on the grease used in the bearings of the *New Pioneer Limited* showed a distinct saving. The previous cost to lubricate this train with plain bearings was 22.5 cents to 26 cents per 1000 car-miles, whereas the cost of grease for the roller bearings under the same conditions averaged 15.8 cents per 1000 car-miles.

The Chicago, Milwaukee and St. Paul Railroad is to be congratulated on its enterprise in making such a bold venture on



The *Olympian*, one of the crack trains of the Chicago, Milwaukee and St. Paul Railroad, running on roller bearings through a mountainous section of the west



Roller bearings on the journals of railway coaches. They reduce greatly the starting effort, thus doing away with the jerk formerly necessary to start a train

two of its finest trains. The results are so satisfactory, both to the passengers and to the mechanical force of the road, that its extension to all of its trains is only a matter of time.

Is the "January Thaw" a Scientific Fact?

NOW that science has demolished our belief in a large number of supposed natural phenomena which it has classified as "old wives' tales," even denying that there is such a thing as Indian Summer, we are glad to have it bolster our belief in the January thaw which most of us, especially the old folks, look for late in the first month of the year. Examination of temperature records of the Weather Bureau furnishes plenty of evidence that in the average year there actually is a marked rise of temperature at that time.

According to Roscoe Nunn, writing in the *Monthly Weather Review*, published in Washington, D. C., by the United States Weather Bureau, "the popular belief in a January thaw—the more or less regular occurrence of a mild spell in the latter part of January—seems to find support in the temperature records of Baltimore and other stations in the eastern states, from Georgia to New England. An examination of the Weather Bureau records of daily mean temperatures for the last 50 or 54 years discloses a marked crest in the graphs of the average daily mean temperatures for the three-day period, January 21-23, at Baltimore, Philadelphia, New York, Boston, Pittsburgh, Raleigh, and Atlanta. The crest is apparently most pronounced over the Middle and North Atlantic States. The temperature graphs for Pittsburgh, Baltimore, Philadelphia, and New York show the prominence of the crest.

"It is not the purpose of the writer to attempt to show that the January thaw is an established periodicity. Reliable and fairly homogeneous records for a half century show that it has occurred often enough to leave a marked impress upon the records for that period. Whether the succeeding 50 years shall tend to obliterate this crest, maintain it, or increase it, remains to be seen. The feature is a striking and interesting one in the Baltimore station records, although it may be of little value as an indication of future happenings.

"'January thaw' was a saying many years before records of satisfactory authenticity had been established.

"No explanation of the cause of the abnormality has ever been offered, so far as the writer knows. It may be worth remarking that it comes just after the head of winter and seems to attend the initiation of lengthening days and the first pulsation toward spring.

"The immediate cause of each occurrence of the spell is readily seen from an examination of the weather maps. It is almost needless to say that they are caused by low-pressure areas moving eastward or northeastward, traversing the Lake Region and the St. Lawrence Valley, or the Ohio Valley and the North Atlantic States, and inducing southerly winds in the eastern states."

Another Bit of Romance Destroyed

THE flivver has replaced the ponderous van of the Gypsy. The natives of interior Labrador are now wearing "store clothes" made in Manhattan sweat shops. The picturesque Dutch windmill is rapidly giving way to the prosaic Diesel engine. American Indians are seen driving farm tractors and traversing the plains of the middle west in Rolls-Royce cars. Their cousins in Canada use canoes made by the white man. The visitor to Tokyo or any other Japanese city is jolted by the discovery that most of the Japanese people wear derby hats, and have replaced the quaint *obi* with common sack coats exactly like the ones we wear. The machine age is knocking the spots off romance.

And now the *yurt* of the desert nomad of interior Asia is rapidly being replaced by a ready-to-use, knock-down-put-up *yurt* made in civilization.

But hold on a minute—what is a *yurt?*

Nomadic people, whose entire wealth consists of foraging animals, must move often—almost daily. They "take up their tents like the Arab, and as silently steal away." They live in *yurts.*

Since time immemorial the natives have trekked day by day across the semi-arid steppes of Mongolia, Tibet and southern Siberia, with *yurts* as their only homestead. And always they made their own *yurts.*

We show a picture of a *yurt.* The picture very nearly explains it. The inside consists of but one room. The outside is of thick felt thrown over a framework or lattice-work of wooden withes or poles. It is warm in winter—and in the great central plateau region of Asia a house must be warm, for there the winters are winters.

Some enterprising outside chap must have had an original idea about *yurts:* make them to specifications, uniform, ship them to central Asia and sell them to these nomads. A picture of a *yurt* of that kind is shown. It was taken in northwestern Manchuria. The manufacturer's name was not furnished us; we would not, however, be at all surprised to learn that *yurts* were listed in the Mongolian edition of the Sears, Roebuck catalog.

Charles Hanson, Consul at Harbin, coast of Manchuria, reports that the new fangled tailor-made *yurts* went over big with the Mongols. They are plunging heavily—and they are by no means poor—on these civilized, mass-production Yankee-made habitations. They also buy quantities of tables, chests and other gear that can be transported on horseback or camel-back. Before long, it is feared, they will take to flivvers—the "tin-canners" of the Asian steppes.

The next thing we know someone will discover a potential market among the Eskimos for a low-priced, standardized, knock-down igloo or circular snow house that can be transported on a dog-sledge. American manufacturers of artificial ice please take notice.

The desert nomad of interior Asia made his own home of poles overlaid with felt, a hole being left in the top for the escape of smoke. Illustration shows one of these warm but indifferently constructed *yurts*

And now comes the machine-age, standardized *yurt* that is furnished the native in much the same manner as one would buy a knockdown garage: in parts that are standard even to the smoke hole in the top

Cathode Rays Speed Drying of Paint Oils

CATHODE rays, which aroused great expectations of practical applications a few months ago when Dr. W. D. Coolidge, of the General Electric Company, exhibited a more powerful machine for producing them, are already fulfilling these hopes. At the recent meeting of the American Chemical Society their effect in speeding up the drying of paint materials was discussed by Prof. J. S. Long of the chemistry department of Lehigh University.

In collaboration with a group of his associates, Prof. Long exposed a number of glass plates coated with linseed oil, perilla oil, and China-wood oil, all standard paint materials, to the action of rays from the Coolidge tube, and also exposed similar samples to blasts of warm air and to beams of ultra-violet rays to obtain comparisons.

"The time required for the oil, without driers, to become dry to the touch or to dry hard, was found to decrease in a regular manner as the time of exposure to cathode rays increased up to 10 minutes," Prof. Long stated. "Perilla oil, without driers, rayed for 10 minutes was dry to the touch in two hours and hard in five hours. Linseed oil rayed for 10 minutes was dry to the touch in

three hours and hard in six hours at 60 degrees, Fahrenheit. Raw perilla and linseed oils, without driers, flowed on the same glass plates at the same time, were wet and not much changed when the progressively thicker films from rayed samples were all dry."

—*Science Service.*

X-Ray Photographs Furnish New Means of Identification

WILL the all-penetrating X ray replace fingerprints as a weapon for tracking down criminals? A spectacular case, the first on record, in which the indentification of a person has been obtained through the use of X-ray photographs, is described in a report made to the American Medical Association by Drs. William Ledlie Culbert and Frederick M. Law of New York City.

In January, 1920, Dr. Culbert operated on a man, designated as "J.L.," for mastoiditis on the left side, a procedure that relieved chronic headache. As is usual in such cases, several X-ray studies were made of the face and head.

"In 1925 this patient," said Dr. Culbert in his report, "went to India and wrote to his family of his intention of going into Thibet; as entry was forbidden by the Indian government, he stated that it would be necessary for him to 'disappear;' that is, to drop officially out of sight. In the meantime he gathered his caravan together and encamped temporarily with some friends on the banks of the Indus River in Kashmir. On June 8, 1925, great alarm was occasioned by his sudden disappearance, and search was started along the river. Seventeen days later, the bodies, first of one white man, and then of another, both badly dismembered and disfigured beyond any possibility of recognition, were found in the river, 70 miles below camp. We were appealed to by the family for possible means of identification and suggested the scar of a simple mastoid operation on the left side.

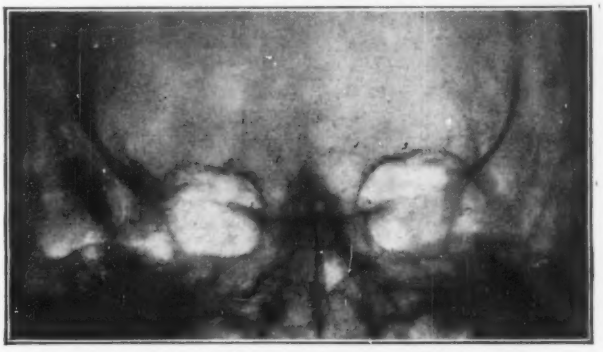
"One of the bodies showed such a scar and was shipped to New York. 'J.L.' was heir to much real estate to which title could not be given without positive identification, which was made increasingly necessary because of the written statement of 'J.L.' to his family of his intention to disappear into Thibet.

"On being asked if we could furnish means of more positive indentification, we replied unhesitatingly that we could do so, for we still held in our possession roentgenograms of the nasal accessory sinuses and of both mastoid bones of 'J.L.,' taken in 1918. We had noted in many other cases the absolute identity of roentgen-ray pictures taken of these structures, in the same patient, after lapses of five, 10, 15 or more years. Although we had never before had occasion to use the fact, as shown by roentgenograms, of the unchanging shape, size, contour and relation to neighboring structures of the pneumatic cells of the skull as a means of personal identification, these facts could unquestionably so be used."

The second set of X-ray pictures established conclusively the identity of the corpse. In both sets the nose wall of the orbit of the eye was curved more on the right than the left and the upper curve of the right eye-socket was slightly flattened in both pictures. Various other formations of the bones of the face were found to correspond. The identification was further confirmed by the recognition of three gold inlays in the teeth of the body by the dentist who had attended "J.L." in 1924 and 1925.

The whole subject of roentgenography of the head as means of identification for criminals has barely been touched, the doctors believe. It offers advantages over finger printing in that finger tips can be intentionally mutilated and for some reason the head seems to be preserved more often than the hands in war, accidents, and certain murder cases. Any amount of deforming surgery, moreover, cannot destroy all the identifying landmarks of the skull bones.—*Science Service.*

X-ray picture of the skull of "J. L." taken in New York five years before he was murdered in Thibet. The eye sockets and the structure of the nose show faintly. The X-ray on right was compared with this



X-ray of the skull of corpse found in Thibet. There is not one chance in a trillion that the analogous details, marked on this and the cut at left by corresponding numerals, would be the same in different skulls

Rust in Water Pipes Removed by New Method

RUST-CHOKED iron water pipes in a 35-story New York office building have been cleared by a new acid solvent, and the vast expense of repiping the whole structure avoided. The process, worked out by F. N. Speller, E. L. Chappell and R. P. Russell of the Massachusetts Institute of Technology, is expected by engineers to become a very important factor in building management.

It has long been known that a solution of hydrochloric acid in hot water will dissolve rust, but the drawback has been that it will also dissolve iron and steel, so that it has never been considered practicable for use on a large scale. The three Massachusetts engineers, however, added an organic "inhibitor," which has the effect of preventing the acid from corroding the metal while still allowing it to attack rust.

In order to carry out their operations with the least possible inconvenience to the tenants, they divided the plumbing of the building into sections, attacking these one by one on Saturday afternoons, so that the solution could get in its work and be flushed out of the pipes before the resumption of business on Monday morning.—*Science Service.*

A New Way to Get Rid of Moles

THE lowly mole, long a nuisance to the farmer and gardener, is threatening the golfer's domain. Requests as to best methods of eliminating the animal duffer come frequently to government mole experts, according to James Silver, mole and rat specialist.

Golf authorities have been trying three chief methods of control: poisoning, trapping and the use of repellents. Poisoning has proved disappointing. If applied in the form of strychnine, arsenic or barium carbonate on vegetable bait, it produces poor results because the mole is carnivorous.

Trapping is slightly more effective. However, traps are bulky and clog up the golf course. Moreover, most traps must be placed in the mole runway, where the mole will not touch them. He is extremely sensitive to anything foreign in his burrow.

Repellents, or odorous chemicals whose nauseating fumes drive the mole away, are effective for short periods, at least. A common repellent goes by the high sounding name, paradichlorobenzine. Some time ago a New York State golfer wrote the United States Golf Association that he had experienced excellent results with it. He opened runways at intervals of 6 to 10 feet, dropped a teaspoonful of the poison into each, and put back the soil. No further activity in the area was noted.—*Science Service.*

Precooling Fruits

AN interesting method of preparing fruit for trans-continental shipment is depicted in an illustration reproduced in these columns. After the usual refrigerator car has been loaded and iced, a fabric pressure tube is attached to the car at the respective vents on the roof, and a steady circulation of cooled air is maintained for some time by means of a power-driven fan mounted on a small motor vehicle, as shown. By this means the air is made to pass over the ice, where it is cooled, and then to permeate the

A special motor-driven fan on the motor truck circulates air in the refrigerator car, lowering the temperature rapidly to the ultimate low

contents of the car. Then it is drawn into the second ice bunker at the near end of the car, up through the ice contained in it, and back through the machine.

This treatment results in the maintenance of a constant, steady, heavy draft of cold air moving through the load. This quickly removes the latent or field heat of fruits or vegetables and reduces the temperature so that the ice in the car can function with much greater efficiency. By this means the temperature is held down to such a point that the consumer at destination receives fully ripened fruits and vegetables that are properly matured and fit for immediate human consumption.

With precooling of cars "full-slip," vine-ripe cantaloupes that are full of sugar when shipped, can readily be transported, arriving at their destinations in fine condition and ready to use.

The precooling process requires from four to six hours, reduces the temperature from 105 degrees at the start of the operation to below 50 degrees, and the interior temperature of cantaloupes in the load to the same point, namely, 50 degrees. At the completion of the service, the temperature at the top of the load is as low or lower than that at the bottom. This insures the best of carrying conditions.

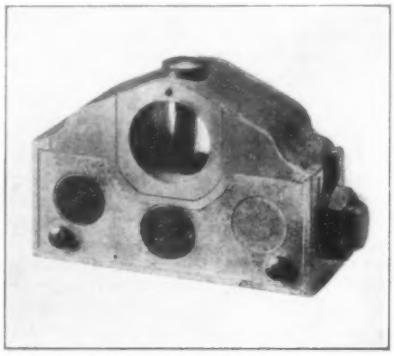
Many tests have been made of actual carrying temperatures and in all cases records show that shipments precooled at the time of loading insure the best deliveries. This means that peaches, pears, plums, grapes, and so on, can be brought to a riper stage and secure close to full sugar content before picking, thereby enabling the grower or shipper to command higher prices for better quality. The precooling of grapes of all varieties results in good deliveries.

How ripe can a given kind of fruit or vegetable become before picking, and still reach the market in good condition? How immature can the same variety be harvested without sacrificing dessert quality to such an extent as to make the fruit undesirable and reflect undesirably on the industry? In the first instance the answer depends upon the temperature in transit and methods of handling in order to arrest ripening—and in the next instance, upon the ability of the fruit to retain, after harvesting, the physiological and chemical changes necessary for normal ripening without loss of flavor and body.

Obviously, if the heat of the growing fruit or vegetable can be quickly forced out of it at the proper point, its further development will be more surely retarded than where it ripens by slow stages while cooling in the usual refrigerator shipment.

The Great Domes of Medieval Architecture

WE regret to find that on page 346 of our October issue the interior diameter of the dome of St. Peter's was by some error given as 200 feet. This, of course, is wrong, the actual diameter being 137 feet, six inches. This is slightly exceeded by the dome of the great cathedral at Florence, whose interior diameter is 138 feet, six inches. The largest existing dome is that of the famous and ancient Pantheon at Rome which is now over 1600 years old. This dome measures 142 feet, six inches in internal diameter.



A casting five inches long, contains the efficient speed limiting device

Limiting Automobile Truck Speed

THE tremendous increase in the use of heavy duty internal combustion engines for automotive service, raises the question of regulating the speed of automobile trucks, both for economy in fuel and mechanical life, as well as for safety.

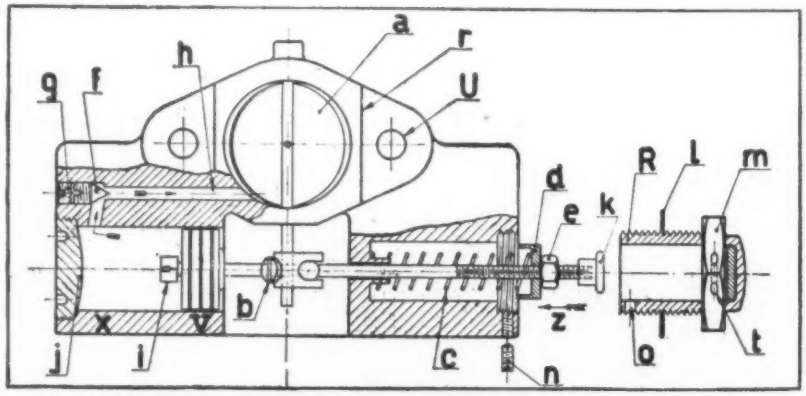
By regulating the number of revolutions of the engine, it is possible to regulate the speed of the truck and accomplish a considerable advance in all these requirements.

Recently a new type of automatic fuel and speed controller has sustained severe and successful tests by officials of the New York Automobile Club, in conjunction with the Garford Motor Truck Company. Its construction and operation can readily be noted by reference to our illustration.

The moving mechanism is enclosed in a solid block of cast aluminum, 5 inches by 2 1/8 inches. This block is bolted between the manifold and the carburetor and can be attached in a few minutes. The fuel mixture passes from the carburetor through the main orifice in which the butterfly disk *a* rotates on a stem. The same stem is also extended to couple up with the control mechanism at *b*. In the cylinder of the regulator *x*, moves the piston *v*, attached to the piston rod *i*.

A narrow channel *h* connects the main fuel channel with this cylinder. The capacity of channel *h* is limited by the set screw *f* locked by the nut *g*. Attached to piston rod *i* is the counterbalance spring *c*, the tension of which is regulated by nut *e*. The handle *k* serves as a buffer to absorb vibration when it strikes the shock absorber placed in cylindrical cup *r*, enclosing the end of the piston rod.

When the motor is silent the throttle *a* is parallel with the axis of the fuel channel—that is, wide open. When the motor starts, a vacuum is created in the main fuel channel. This vacuum is communicated through channel *h* to the cylinder. More or less vacuum operates the piston *v* and its travel is communicated through link *b* to throttle *a*. Thus a balanced condition is maintained according to the regulation of spring *c* by whose adjust-



Longitudinal cross-section of the automatic truck speed regulator. The details of its mechanism are explained in the column above

ment the desired speed limit of the motor's revolutions can be established and maintained. After being locked and sealed, the rugged design of this instrument guarantees against wear and tampering.

When a load is suddenly put on the motor, as upon climbing a hill, the engine begins to slow down, the vacuum decreases and the throttle opens, thus allowing full flow of fuel to the engine until its speed again approaches the limit set.

Tested on a 25-mile run, with and without the mono-block regulator, a one and one-half ton truck showed 18.7 percent fuel saving by the use of this regulator.

Loader Straddles Railway Cars

AN ingeniously contrived piece of logging equipment illustrated in these columns, permits entire trains of flat cars to be loaded with logs without the usual necessity of providing a special siding for the logging crane in order that the cars, one by one, may be spotted beside it. Instead of this the crane is mounted on a large frame through which the cars may be drawn, and the cars are spotted directly in front of it.

The operation of this apparatus is somewhat as follows: The crane travels on its own wheels (shown elevated in the illustration) to the loading point. Here four vertical struts are lowered to the outer ends of the ties and the trucks are raised sufficiently to permit the entire train of flat cars to be backed through the loader. Then, one by one, as the switching engine moves them forward, the cars are loaded.

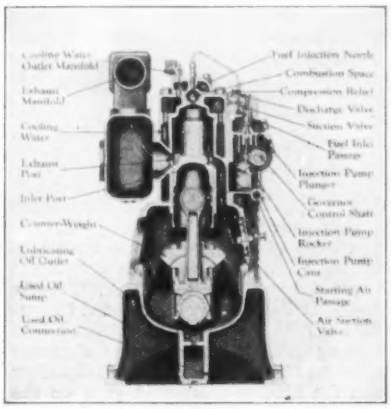
When the local loading job is completed, the process is reversed. The loaded train of logs pulls away, the trucks of the crane are lowered to the tracks and the vertical struts are raised. The crane itself is now ready to decamp to the next job. More than 100 cars a day may, it is said, be loaded in this simple manner. The loader will not only move itself to the next location but if necessary it will take a train of "empties" with it.

The log loader that virtually carries its own side track. The flat cars emptied of logs, are run under it between its legs. The crane moves on its own wheels

A New Field for Diesel Engines

THE past few years have seen many interesting developments in Diesel engines and a rapid widening of the field of application for this type of prime mover. Thousands of interesting applications have been made, which have demonstrated that this engine will produce a horsepower hour with a fuel and lubricating oil cost of approximately one half cent, or a kilowatt hour for approximately three quarters of a cent. With labor and other charges added, the total power cost is seldom more than one and one half cents per kilowatt hour.

Most of the development of the Diesel engine has been in connection with the largest sizes, and less attention has been given the smaller units. In the past year, however, a number of higher speed, lighter weight, two-cycle Diesel engines have been brought out. This new development places them on a competitive basis with the gasoline engine in these smaller sizes. There are so many places where the power problem can be solved by a self-contained prime mover in ratings from about 30 horsepower up, that these new developments are of decided interest.



Section of 15 horsepower, high-speed Diesel engine

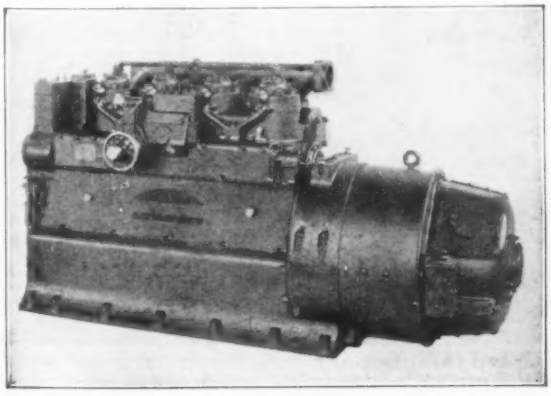
The accompanying cross-section through one of these engines, which has a rating of 15 horsepower at 800 revolutions per minute, shows in a very striking way the simplicity of its construction. In this engine the fuel oil is sprayed through a nozzle into the combustion space above the cylinder proper, by means of a plunger pump which is driven by a cam mounted on a shaft extending along the side of the engine and about half way up. This shaft is driven by means of gears from the main crank shaft. One of these plunger pumps is required for each cylinder.

The compression pressure—that is, the pressure of the air at the top of the cylinder when the piston is in its highest position—is about 500 pounds per square inch, while in the gasoline engine this pressure is only about 50 pounds per square inch. When the air is suddenly compressed to 500 pounds the temperature rises to approximately 1000 degrees Fahrenheit and this heat fires the oil.

Engines of the type shown in the accompanying illustrations are built in a number of modifications, to meet practically every service requirement. For example, they can be equipped with radiator cooling and with a built-in clutch of the automobile type, to be used for such applications as dredges, power shovels, locomotive type cranes, et cetera. This same type of unit can also be equipped with a pulley and used for conveyor drives or for any application where it is desired to use a belt drive. Since the speed of units matches with many types of driven machinery such as centrifugal or screw pumps, it is also possible to direct-connect this type to the driven machinery.

In some cases these engines equipped with radiator cooling have been mounted on skids, together with the necessary fuel and air tanks, switchboard and other small auxiliaries, to make a semi-portable power plant for use in construction operations and similar service.

This new Diesel is equipped with both manual and governor control. In the former a half turn of the small regulator shown just a little above the center of the engine, will vary the speed through a wide range. Where the engine is to be operated for long periods at a slow speed the governor control wheel is turned and the engine operates at this slow speed under governor control; that is, the speed will not vary over or under the speed for which the governor is set.



A high speed, comparatively small Diesel - electric unit, clean and compact in design. At 800 revolutions per minute, it develops 40 kilowatts of electric power, or about 55 horsepower. It typifies the newer models

For starting, compressed air at a pressure of about 250 pounds is supplied by a small air compressor, and stored in small tanks. The engines start instantly. Starting the largest Diesel engine is easier than starting an automobile engine.

Almost automatic in its entire operation, the lubricating system particularly requires practically no attention, every part being flushed by streams of oil forced under pressure by a pump or a mechanical lubricator.

The big advantage of the Diesel engine is of course the low fuel cost. The full Diesel, that is the high compression type, will burn very low grades of fuel and will burn them more efficiently than the lower compression or semi-Diesel. It will readily be seen that the higher the compression, the higher the generating temperature, and hence the more complete is the burning of the fuel. It is for this reason that more efficiency is developed. The gasoline engine not only requires a higher grade of fuel but, since it burns it much less efficiently than does the Diesel, it requires a great deal more fuel. Fuel for Diesel engines can be purchased for from three to eight cents per gallon, depending on the locality, and the quantity which is bought.

Unique traveling log house made by Washington man from one log of a fir tree that was 311 feet high. The owner says it is comfortable

River Control Measures Threaten Pearl Buttons

THEY wiped out the forests from the upper end of the Mississippi valley, and that let loose heavy spring floods. They build wing dams in the river to control the floods, and that threatens to take the pearl buttons off our shirts. For the pearl-button industry of the United States, well over a million dollar affair, centers around Muscatine, Iowa, and depends on the shells of the river mussels, more often called river clams, that formerly abounded on the muddy bottom of the Mississippi and its tributaries.

The difficulty is, explains Prof. N. M. Grier of Des Moines University, who has been investigating the situation, that the flood-controlling dams allow sediment to settle in their backwaters close inshore, and that this sediment is smothering the mussels wholesale. Closed seasons over stretches of the river during the past five years have given an opportunity for the testing of views on the depletion of the mussel beds. As a result of his surveys, Prof. Grier recommends that the sloughs or side channels be permanently closed to mussel fishing, in order that they may furnish a convenient source of mussels for restocking the main stream when legislation looking toward the improvement of present unfavorable conditions shall have had time to become effective.

—*Science Service.*

A Douglas Fir House

BECAUSE his friends back east were skeptical about his stories of the large trees which grew in the forests of western Washington, to which part of the country he had migrated, E. A. Wade, a former Mississippi farmer, decided to convert the butt of one of these trees into a traveling house mounted on a motor trailer, and bring it east with him to show them the kind of trees that grew on the west coast. He therefore procured a 9 by 16 foot log, bored a two-inch hole through the center, then burned this out to four feet and with an electric buzz-saw, and adzes completed the job of hollowing the log. This work took three men five weeks to complete.

The interior, transformed into a modern two-room house, with two beds, breakfast nook, cupboard and wardrobe, was wired for electricity. An oil stove was employed for cooking.

This comfortable home was next mounted on a chassis, as shown in our illustration, and a tour to the homes of the owner's skeptical friends was made.

The tree from which this log was cut contained a total of about 50,000 board feet of lumber. It was 311 feet high and 434 years old.

Swedes To Make Sugar From Wood

A NEW process for making sugar out of sawdust was described by Prof. Erik Haegglund of Abo, at the coal and wood chemistry conference recently held in Stockholm, where he reported that at Geneva where the process is being tried on a commercial scale, from 65 to 70 percent of the sawdust by weight can be converted into sugar.

For Sweden, where forestry is one of the dominating industries and where most of the sugar has to be imported, the method is likely to become of the greatest importance. Several hundred thousand tons of "wood sugar" can be produced annually from easily accessible raw materials, it was stated.

—*Science Service.*

Vaccination Exonerated of Causing Syphilis

ON account of the circulation of false statements claiming that vaccination for smallpox will lead to syphilis, the Surgeon Generals of the Army, Navy and United States Public Health Service have issued a joint denial of this misconception. They declare that under present methods there is no chance of such infection.

Since 1917 there have been vaccinated in the Army and Navy of the United States approximately 5,650,000 persons, state the medical chiefs, not one of whom has ever developed syphilis as a result of vaccination.—*Science Service.*

Interior of the log house shown above, looking toward the rear. This photograph shows convenient arrangement of berths, tables, and chests

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

Spring Safety Stick

AERO DIGEST carries an interesting description of a spring safety stick which has been developed, but not patented, by the Alexander Aircraft Company, of Denver, Colorado. It is intended to minimize the very real danger sometimes present in flying instruction when a nervous student "freezes" to the control.

The safety stick consists of a short lower section of tube with a flanged disk at the upper end; an upper section of tube with disk at its lower end and flying grip at its upper end; and a spring under tension inside the lower and upper tubes. The spring holds the disk on the upper section of the stick tightly in the cupped flange on the lower section. The tension is such that in ordinary flying the stick remains straight and inflexible.

The spring in this airplane control stick will often prevent accidents

In emergency cases where the student becomes frightened and in his excitement insists on some erroneous control, the instructor can easily resume control, as the flexible joint in the student's stick bends under heavy effort. The device has been tested in a variety of flight attitudes and has proved satisfactory.

"Time of Flight" Clock

S. SMITH AND SONS, a British firm, have brought out an interesting "time of flight" clock. The subsidiary dial records the time of flight in hours and minutes. When commencing a flight, the winding button is pressed upwards, which starts the trip mechanism. At the same time a red disk appears. A second push of the button stops the trip mechanism and the duration of the flight is thereby recorded.

World's Smallest Balloon

LEO STEVENS is one of the best known pioneer balloonists in the world, and has made 4911 ascensions without accidents. He has now produced the world's smallest balloon which should put the fascinating sport of ballooning within reach of anyone so interested. The "Golden Toy," as it is called, is so compact that it requires only a small space in an automobile trunk for its storage or transportation. In addition to Stevens' own weight of 138 pounds, it carries 84 pounds of sand ballast. He has flown in it from Englewood, New Jersey,

This novel aircraft clock records the actual duration of a flight

across the Adirondacks, a distance of 350 miles, in 11 hours, which is remarkable speed for a craft without motive power other than the force of the wind.

The dimensions and weights of the "Golden Toy" are as follows: capacity 4000 cubic feet; envelope weight 29 pounds; car 48 ounces; valve 16 ounces; net 47¾ ounces; load ring 32 ounces; guide rope 96 ounces; traveling carry-all 33 ounces; sand bags eight ounces; anchor six ounces; flag and map six ounces. The lightness is due to extremely clever design, and to the use of a new material, "intestogg," in the envelope, made from a diluted emulsion of the intestines of a goat or an ox, with silk thread added under high pressure and temperature.

The Great Delusion

NO popular book on aeronautics has ever aroused so much controversy as "The Great Delusion" by "Neon" (published by the Dial Press, New York). "Neon" is a well-informed writer, who hides his identity under this nom-de-plume always, presumably, to guard himself against bodily attack by aeronautical enthusiasts. Perhaps his age of 60 years is one of the reasons why he is so hostile to our hopes of completely conquering the air. He writes clearly, basing logical argument on many carefully garnered facts.

Neon's case against the airship looks particularly strong. In this chapter on "Principles of Transport and Navigation" he states:

> 1. Any practical vehicle of transport must have a power of motion much in excess of the rate of any possible movement of the medium on or in which it operates.

Leo Stevens in the basket of his tiny balloon, the world's smallest

Perfectly true. But Neon is still thinking of airships having a maximum speed of 50 to 60 miles per hour. The large airships of 5,000,000 cubic feet now projected or in process of construction, will have speeds of 100 miles per hour or more. Still larger airships will be even more independent of head-wind considerations.

> 2. No vessel must depend for its navigation in open waters upon outside help, although near the coast, lighthouses, buoys, and beacons are valuable aids to navigation and pilotage.

A very reasonable proposition. But with the aid of astronomical instruments, smoke flares for taking drift readings, and Behm's acoustical height indicator, the navigation of the airship over sea can be made to attain a high degree of perfection.

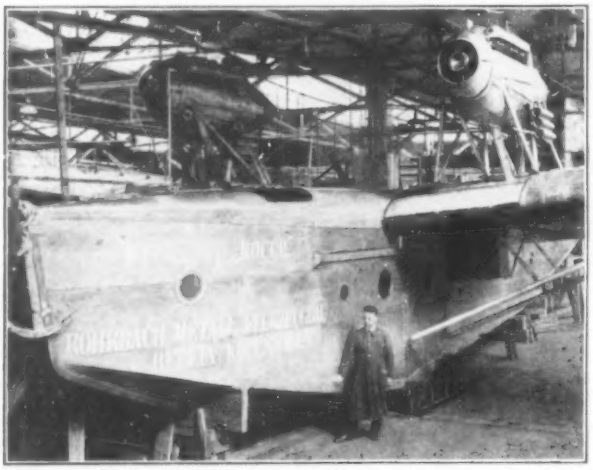
> 3. A ship must have harbors and anchorages.

Neon points out quite reasonably the difficulties in mooring and housing airships, and the tremendous expense of

mooring masts and huge hangars. But we are only at the beginning of the real effort in this direction. While the airship dates back some 40 or 50 years, mooring masts have only come into use in recent years.

4. Ships must be capable of being readily handled for berthing and must be safe when berthed.

The airship is indeed somewhat clumsy while being berthed, and requires great manpower. But has Neon heard of the tractors and other mechanical appliances which will reduce the number of men needed to a ground crew of a dozen or so?



The Rohrback *Rocco* in the process of assembly. Marine fittings and a heavy sea anchor for emergency use are to be seen at the front end of the huge hull

When a large steamer is docking, quite a number of tugs seem to be needed.

5. Any vehicle to be a practical and safe means of transport must be free to stop at any time without risk of disaster, and its stability at rest or in motion must not readily be disturbed.

And then Neon goes on to say that great airships cannot remain at rest in the air owing to lack of stability; airplanes, because of the law of gravity. But a ship at rest in a rough sea is none too comfortable either. A multi-engined flying machine need *not* stop except when it has reached its destination. An airplane of the modern type, capable of slow landing, and short landing run, can stop its engines and alight on *almost* any territory.

6. The useful load carried—cargo, mails, and passengers—must be in reasonable proportion to the effort and expense of such transport; in other words, commercially the end must justify the means.

It is true that the pay load of the airship is small, but not small in proportion to the horsepower employed. And speed is worth paying for.

In disparaging the airplane, Neon's conclusion, based on his observation of the experience of Great Britain, is that it can never be made to pay. In the United States, however, several air transports are making it pay, and one company is making very large profits. He says "The train will coast on a 2 percent grade, whereas an aeroplane requires about a 20 percent grade." The modern airplane needs only a 10 percent grade to coast. A train is enormously heavy compared to the weight of its passengers while the airplane can devote 20 percent of its gross weight to passengers. He says "It is calculated that a passenger's risk of death on the railway is so infinitesimal as to be negligible, one in 1,700,000,000." But airplanes have only just begun to get into their stride from the point of view of safety.

Nowhere does Neon place a true value on predominating speed. He is logical, plausible, yet almost entirely wrong.

Rohrback *Rocco*

THE roc is a "fabulous mythical bird of Arabia, so huge that it bore off elephants to feed its young." Apparently *rocco* is the German equivalent of this name and it is a reasonable appelation for the latest Rohrback flying boat, which carries two 650 horsepower Rolls-Royce Condor engines, has a wing span of 85 feet, a wing area of 1010 square feet, a useful load of 7940 pounds, and a gross weight of 21,130 pounds.

Since flying boats alight on a softer medium than hard ground, and have practically unlimited distances in which to make a get-away, it is reasonable to suppose that they can be loaded more heavily per square foot than land planes. Still it is extraordinary that practical flying boats can be loaded to over 21 pounds per square foot of wing area. It is due to this high loading that with a crew of three, ten passengers, and 300 pounds of baggage, a range of 1490 miles is possible. These figures bring a service between Newfoundland and the west coast of Ireland within the realm of possibility.

Aircraft insurance men have always stressed the necessity of many safety measures in the case of seaplanes cruising for long distances over water. Some of these suggested safety measures are: practical rafts; collapsible or inflatable boats; life boats; water rudders and perhaps water propellers; quickly detachable wings for use in case of forced landing; smoke signals; and sails for surface cruising when the fuel is exhausted.

From the descriptions of the *Rocco*, we note an additional safety appliance. A very complete wireless equipment is carried on board, consisting of sending and receiving apparatus for both telephony and telegraphy. When the machine is in flight the necessary current is produced by a wind-mill driven generator. But if the machine alights and is disabled, another generator in the hull can be driven by a gas engine, a small wireless pole erected and messages sent from an auxiliary aerial.

The fate of Nungesser and Coli still remains a mystery. Perhaps such a system would have saved the lives of these brave pilots on their attempt to fly from Paris to New York.

A flying-boat hull is generally an affair of beautiful curves, which even in wood mean much work and expense. In the *Rocco*, the hull is of narrow beam, with straight sides; the beauty is less, but the application of flat sheets is simple and inexpensive. Rohrbach used to go so far as to use a flat bottom. In the *Rocco* hull, which is pictured on the streets of Berlin, the bottom has a pronounced V, which lessens impact on alighting and minimizes the chance of leakage; the V bottom is concave. Not only German, but American and Italian designers find this concave bottom a means of diminishing spray. The elimination of spray is particularly important in the *Rocco* because the propellers are tractors, forward of the wings, and therefore susceptible to damage by spray more than is the case with pushers.

Large flying boats are gradually acquiring many characteristics of water vessels. For example, the *Rocco* is provided with heavy marine fittings at the forward part of the hull, and a seagoing anchor. Also great attention is given to watertight compartments. In the *Rocco*, the nose of the boat forms what is known as a "collision" compartment, which is separated from the rest of the boat by a watertight bulkhead. It is in this compartment that is carried such equipment as anchor, ropes, boat hooks, et cetera, and it is this compartment which protects the boat in case of collision.

The rest of the hull is divided into watertight compartments and all the doors in the cabin are made watertight. It is even claimed that with doors and windows (or circular portholes) closed, two adjacent compartments could be damaged and the craft still remain afloat.

The *Rocco* hull on the streets of Berlin. The flat sides make the construction easy and inexpensive

Apology

ON page 168 of our August issue, we printed a drawing of a cross-section of the *Spirit of St. Louis*. This illustration was redrawn from one that appeared originally in the pages of *Aero Digest*.

Through an oversight, the usual courtesy of a credit line was omitted, and we hasten to take this opportunity to express our regrets for this and to thank the aforementioned publication for the use of their illustration.

Pressure Airships

ANOTHER valuable volume has been added to the Aeronautic Library of the Ronald Press, New York City. This is entitled "Pressure Airships," by T. L. Blakemore and W. W. Pagon. Part I deals with non-rigid airships, Part 2 with semi-rigids. The appropriate title covers both types, since in both, the shape of the gas-filled envelope is maintained by means of the excess internal pressure of the gas contained therein. In both types, the compensation for contraction and expansion of the gas is produced by one or more air-filled ballonets located at the bottom and inside of the elongated hull. The top of the fabric ballonet is free to move up and down, and separates the lower part of the gas compartment from the air-filled ballonet. The excess pressure is maintained by blowing air into the ballonet through a scoop placed in the rear of the propeller or by a special blower.

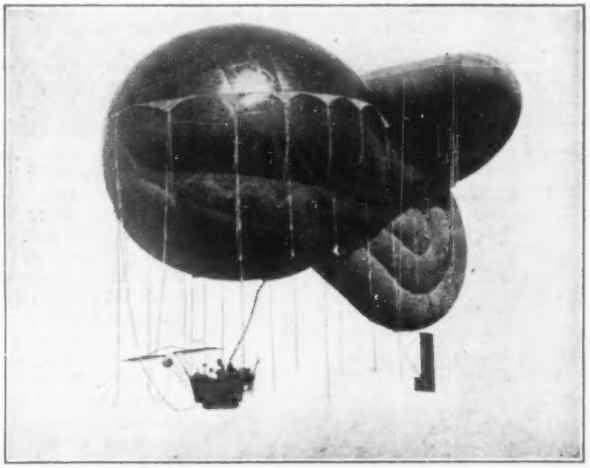
The non-rigid has transportability and the elimination of heavy rigid members as its advantages. Its disadvantages are: heavy fabrics; short life of fabrics owing to high gas pressure; inaccessibility to repair during flight and some unreliability of the pressure.

The non-rigid has a wide range of sizes; from the Goodyear pony blimp of 35,350 cubic feet to the large *Astra* and *Zodiac* airships of French construction, which carry half a million and more cubic feet of gas.

The question often arises whether the non-rigids will be able to exceed the latter limit in size. The difficulty is in eliminating distortion in very large non-rigids, owing to the flexibility of the fabric, which also stretches unequally. H. Naatz, of Germany, has proposed a type of non-rigid airship in which a network of steel tape of one-meter mesh is to surround the entire hull and diminish distortion. It does not seem likely, however, that even with such expedients the non-rigid will be built in much larger sizes than now. At its present size, it serves a number of useful naval and military purposes.

Simple in outline, the non-rigid airship is really a very complex structure. Blakemore and Pagon deal admirably with such matters as hull construction, suspensions, car design, maneuvering controls and other important items.

In the semi-rigids, the Italians are now attempting a monster of 1,800,000 cubic feet, and it is by no means certain that even this is the limit in size. There are very definite reasons why this type has forged ahead of the non-rigids in size. The lower elements of an airship envelope are subjected to less longitudinal gas pressure tension than the upper ones, and hence the envelope has more tendency to buckle here under negative bending moments. The provision of a rigid keel running the whole lower length of the hull opposes this tendency and also serves to distribute the car loads. As a result, the semi-rigid has very nearly the stiffness of the huge rigid airship, and at the same time is lighter, quicker and easier to construct, to inflate, to deflate, and to repair. Part 2 of the book mentioned has a splendid treatment of the theory and design of this promising type of airship.

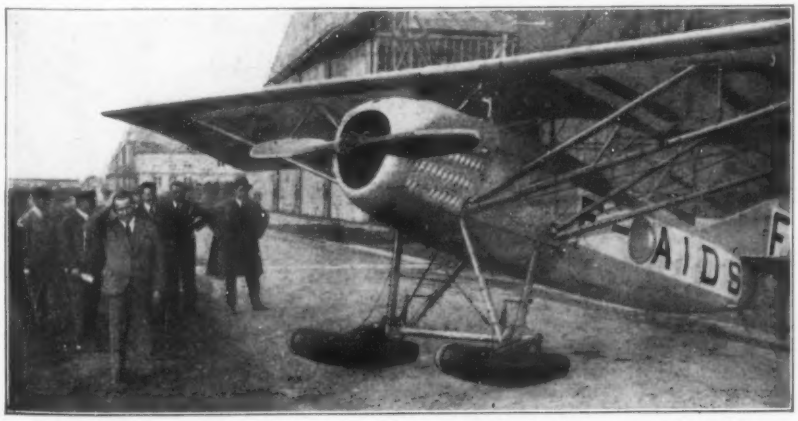


In the nacelle suspended from this kite balloon are a small engine and a propeller. Thus is solved the problem of moving the balloon from one point to another

An Airplane Roller Skid

THE Louis Vinay Aeronautical Works, a French firm well known for its parachutes, has produced a novel form of roller skid for airplanes which is intended to replace the usual landing wheels. The skid is fitted with an annular rubber "caterpillar" band and hydraulic braking is provided. The invention is said to make landings on rough ground entirely feasible and to eliminate the possibility of the airplane turning over on its nose when going over a rut in the ground.

We understand that Alexander Seversky, the well known bomb-sight designer, is experimenting to the same end in the United States, but in a different mechanical form—two rollers are to be mounted on skids on either side of the airplane.



Roller skids replacing the conventional landing wheels are said to make rough fields safe, and also to eliminate nosing over when a rut is hit

A Motorized Kite Balloon

THE spherical captive balloon filled with hydrogen or coal gas was used quite freely during the Franco-Prussian war for military observation purposes. For many years it remained the only method for making observations from altitude. With a spherical balloon, observation in a high wind is difficult. The balloon drifts rather than "kites" to such an extent that a large amount of cable has to be payed out with little or no increase of altitude. Further, the spherical captive balloon spins around and makes observation difficult even in low winds.

On the other hand, the three-tailed kite balloon, shown in our photograph, provides good dynamic lift, which helps in securing altitude and also has excellent stability aloft. However, there remains the difficulty of towing it into position. An Italian military engineer, Colonel Luigi Avorio has now overcome this difficulty by substituting for the ordinary kite-balloon basket, a special nacelle containing a small engine and driving propeller, and with a tail surface attached to provide stability for the nacelle. This seems to have solved the problem of moving the balloon from one point of operation to another.

Helium from Hydrogen

FROM the Chemical Institute of the University of Berlin a report has come that two scientists have succeeded in transforming hydrogen, the lightest of all elements, into helium, somewhat heavier, but non-inflammable. The transmutation was accomplished by the use of palladium, a metal not unlike platinum.

Hydrogen, subjected to the influence of finely divided palladium as a catalytic agent, produced a small quantity of helium.

Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

CONDUCTED BY ORRIN E. DUNLAP, Jr.

High Speed Attained by Marconi Beam

THE British Post Office has inaugurated a radio-beam service between England and Australia which is able to transmit more than 200 words simultaneously in two

Herbert

Model of Marconi's directional beam transmitter as recently exhibited in Italy. The metal reflector is designed to radiate the waves as desired, in the same fashion as a searchlight

directions per minute. Although the cable rates to Australia have been reduced twice since January, the beam rate is a third less than the present cable rate.

According to the time of day—since wireless waves travel better at night—the new beam will be directed on its 10,000-mile journey either eastward over Europe or westward over America. A letter takes one eighteenth of a second to pass from the transmitter in London to the receiver in Australia.

As many as 325 words a minute in both directions have been sent simultaneously over the Australian beam. A beam to Montreal has been working since October, and beam stations for South Africa and India are now in operation.

Battery Receivers Can Be Electrified

BATTERY-OPERATED sets can now be converted into electrical circuits which use the house-lighting socket as the source of current supply, thereby dispensing with all batteries. The change can be made easily and without disturbing the wiring of the receiver. The battery-operated tubes are removed and all battery or eliminator connections are disconnected. Then, in each socket of the set except in the last audio stage, a special adapter is inserted.

The adapters are connected to a cord and plug which fits into a receptacle on the power unit, known as a "powerizer." Through this plug, alternating current of proper voltage is applied to the alternating-current tubes which are inserted in the adapters. The current is at a potential of 1.5 volts for the filaments of the UX-226 (CX-326) utilized as amplifiers, and 2.5 volts for the heater of the UX-227 (C-327), employed as detector.

The last audio socket is equipped with an adapter plug which transfers the signal to a large power tube, the UX-210 (CX-310) in the powerizer, from which the loudspeaker is fed through an output filter. All battery terminals of the set are connected to three posts on the powerizer, thereby deriving proper "B" and "C" voltage for all tubes. A high-voltage, full-wave, rectifying tube UX-280 (CX-380), is employed in the power unit. It is found that the new tubes in most sets operate properly at the same values determined correct for the Atwater Kent models, while the Radiola 20 necessitates angle adapters to save space. Grid resistors are necessary with the Number 20 and they are provided so that the set will be correctly balanced, otherwise it will oscillate.

The control of sets equipped in this manner is obtained by scaling down the antenna energy by a potentiometer of high resistance (more than 25,000 ohms).

Who Owns the Ether?

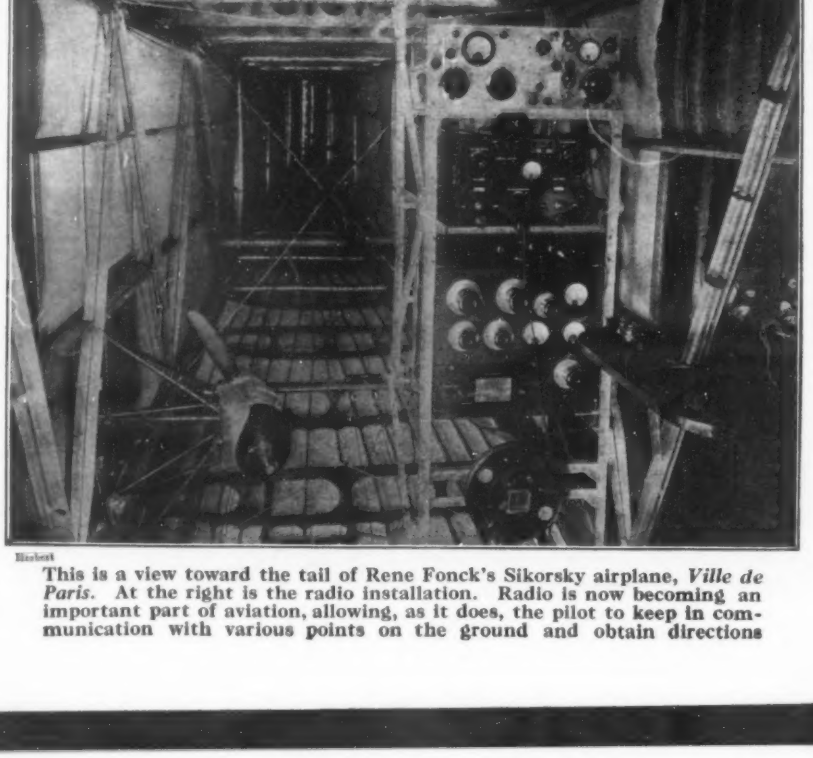
JUDGE STEPHEN B. DAVIS in his new book, "Law of Radio Communication," considers at length most of the controversial phases of radio, such as federal jurisdiction, state jurisdiction, conflicting rights in reception and transmission, property rights, the broadcasting of copyright matter, the control of broadcasting programs, libel and slander and international law.

It is the contention of Judge Davis, Hoover's former right-hand man in radio matters, that even though the ether had material existence so as to be susceptible to ownership, there would still be a flaw in the argument of those who assert title in either federal or state government.

"Certainly it does not belong to the United States, whose limited powers are defined and restricted by the Constitution," contends Judge Davis. "That document will be read in vain in search for any applicable provision. The power to regulate commerce obviously does not confer title to the medium by or through which that commerce is carried on. Sovereignty, police power and regulatory control are wholly distinct and independent of ownership. The federal government exercises full jurisdiction over navigable waters; yet it does not own them, nor their beds nor their banks. So likewise with the states. They may have sovereignty over everything within, below and above their areas, but not proprietorship."

Discussing the constitutional rights of station owners, Judge Davis declares as follows:

"The effect of the 1927 law in terminating existing licenses and requiring the obtaining of new ones, is to deprive the station



Herbert

This is a view toward the tail of Rene Fonck's Sikorsky airplane, *Ville de Paris*. At the right is the radio installation. Radio is now becoming an important part of aviation, allowing, as it does, the pilot to keep in communication with various points on the ground and obtain directions

owner of his right to operate his apparatus, whatever that my be, unless he executes the required waiver and is then able to bring himself within the rule of 'public convenience, interest and necessity.' "

Much is Expected From the New Tube

A NEW and improved radio-frequency amplifier labeled UX-222, known as a four-element tube, because it has a filament, plate, and two grids, has been introduced to manufacturers, who are planning their sets for next year and to experimenters in the realm of broadcasting. It is a battery-operated tube and according to engineers it has great promise in the experimental and development fields.

The standard tube has one grid, while the new amplifier's two grids are placed concentrically with each other and with the filament. This arrangement constitutes a distinct departure from the conventional vacuum-tube construction. The control grid element, which corresponds to the regular grid in receiving tubes now in general use, is connected to a terminal cemented to the top of the glass bulb. The other grid element, known as the "screen grid," is attached to a terminal in the base in the standard way.

This UX-222, when properly connected, is said to increase the signal voltage about 30 to 40 times, as compared with a five to seven voltage increase obtained with the average general purpose tube. When employed as a space-charge-grid tube, the received signal voltage may be intensified by more than 150 times per stage of amplification. The tube requires but 0.132 amperes of filament current at a voltage of 3.3. Thus it can be operated easily with three dry cells connected in series.

The general application of this tube is said by engineers to be still a matter of reflection; nevertheless, those close to the industry look upon it as the index to a new set, probably one with fewer tubes, because the UX-222 in the radio-frequency amplifier circuit can do the work of several of the present tubes and do it more efficiently. Nine times out of ten the introduction of a new tube is the vanguard of a new receiving set.

It is pointed out by engineers that the shortcomings of the conventional three-element tube is, perhaps, most greatly manifest in what is called inter-electrode capacity, or the capacity between the electrodes themselves plus the capacity between the more or less parallel connection wires that make contact with the circuit through the base of the tube. This capacity allows some of the plate-circuit energy to be fed into the grid circuit, with a tendency to unbalance the circuit and create a state of oscillation. Such conditions are detrimental to the relay action of the tube and are likely to distort the signal.

The extra grid in the UX-222 is said to eliminate self-capacity. Therefore, no neutralizing devices are needed in the circuit to prevent feed-back; the circuit is simplified; howls are minimized and much greater signal strength is obtained.

HHK On the Air

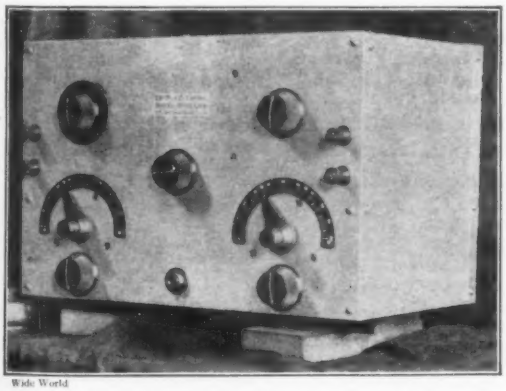
STATION HHK, the Republic of Haiti's broadcaster at Port-au-Prince is vibrating the ether on the 361.2 meter wave. The time to tune for this station is on Fridays from eight to nine P.M., Eastern Standard Time, when music and talks in French and English are radiated; Thursdays 7:30 to 8:30 P.M., band concert; Saturday 6:45 A.M. to 7:15 A.M., educational lecture, in the Creole language, and music.

Radio for Aircraft

BECAUSE of unfavorable operating conditions encountered in flight, and because of space and weight limitations imposed on the equipment, reliable communication can be maintained only by use of equipment of the highest grade especially adapted for aircraft purposes, is the opinion of Malcolm P. Hanson, radio expert of the United States Naval Research Bureau.

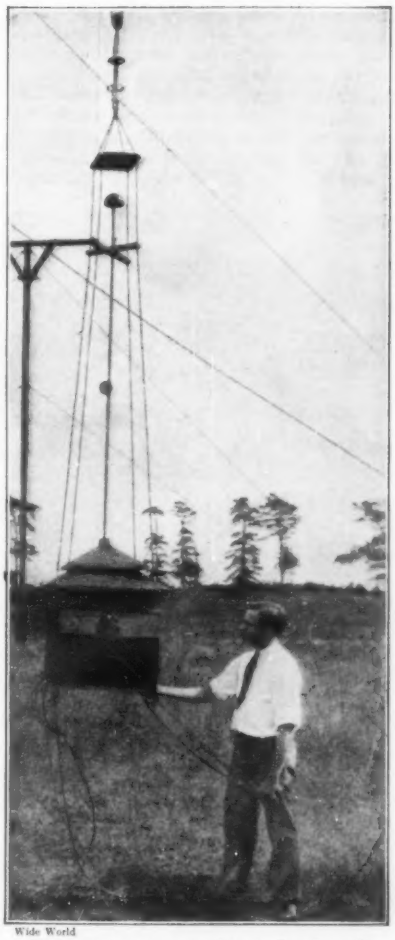
"The only condition favorable to communication is the normally high altitude of the single-wire antenna above the energy absorbing ground and obstructions," explains Mr. Hanson. "But the disadvantage exists that the customary trailing wire with a lead weight or 'fish' on its end must be paid out from a reel after the plane has reached a safe altitude, and again must be reeled in before landing to avoid its loss. This wire is usually from 100 to 400 feet long. Instead of the customary ground, connection is made to the metallic framework and bracing of the airplane itself. The engines, fuel supply tanks and piping must be well 'grounded' to the remainder of the structure, and other metallic objects should be either grounded or well insulated from adjacent metal to avoid dangerous sparking, reception clicks, and poor radiating conditions.

"The continuous vibration produced by the engine and by the wind blast require a most durable but resilient construction as well as careful flexible suspension of the equipment, while often additional cushioning is necessary to avoid damage from a hard landing. The equipment must be light in weight and very compact, yet be accessible in flight for simple adjustments and occasional replacements of tubes. Reception is rendered difficult, not only by the motor and propeller noises, but also is often considerably interfered with by the engine ignition system, which itself acts like a very broadly tuned spark transmitter. The resultant continuous clicking and growling noises in the receiver may completely blanket out reception of the desired radio signals. While the interference can be reduced by several methods, it can be entirely eliminated only by surrounding all parts and wiring of the ignition system with metallic 'shielding,' grounded at frequent intervals to the engine structure. A ringing, so-called 'microphonic' sound in the receiver, set up in the receiving tubes themselves by vibration and external noises, is another factor which must be guarded against by special design."



Wide World

At the left is illustrated the compact radio receiving set that was carried on board the airplane *Old Glory* on her fatal trip. Simplicity of operation and complete shielding are two of the important features of this radio receiver



Wide World

Five-meter transmitter developed by the General Electric Company. The entire station is housed in the box, which is hauled up 60 feet

Antenna Formula

A NEW technical compilation of formulas and tables for the calculation of antenna capacity has just been prepared by Dr. F. W. Grover, consulting physicist of the Bureau of Standards. It

includes formulas for calculating the capacity of almost every kind of antenna —the single horizontal wire, single-wire inverted antenna, single-wire T antenna, horizontal "cage" antenna, parallel-wire V antenna, conical antenna, umbrella antenna and fan or harp antenna.

There are also calculations of capacity of lead-in wires and tables for antenna capacity calculations. The document is known as Bureau of Standards Letter Circular 224.

Herbert

Laying the ground wires for the station at Rugby, England. The plow cuts the furrows just wide enough for the wire, which is reeled out from the drum

Television in the Home

WHEN will homes be equipped with television receivers? A noted radio engineer, distinguished for his work in television research, recently said: "How long? Well, it all depends upon what the public would be satisfied with in the way of pictures. If they would care for a rather poor picture we could give it to them today, but I think it advisable to move forward, nearer perfection before we begin to broadcast pictures.

"We might be able now to send out pictures comparable in quality to the music radiated in 1920—therefore, you see we are not yet ready to broadcast perfect pictures. However, we know more about radio and have improved apparatus since the first programs were broadcast, so that helps us to advance a trifle faster in television research. The television problem today is to simplify our apparatus. It must be made practical and economical so that it can be used in the home at no more cost than broadcast receivers are today. I should say we still have a long way to go."

Latest design in photo-electric cells introduced by the General Electric Company. This device is known as the eye of radio because of the part which it plays in television. It transforms light fluctuations to variations of an electrical current

Broadcasters Select "Nemo" as Radio Term

A NEW word to supplant "remote control" has been coined by engineers working on the WEAF network. A broadcast to be made from a point outside the studio is no longer called a "remote control job," but "nemo." Since 1923 the engineers have wrestled with the appellation "remote control" in reports and instructions. They complained that it was too long and often the meaning was garbled. Other names were suggested and tried but without success. One day while giving hurried instructions over a wire installation, a maintenance engineer stumbled upon "nemo." The operator at the other end of the line caught it at once. Soon the term was recognized and became so popular with the staff that it was adopted as an official term. Stations WEAF and WJZ now have 28 "nemo" points from which programs are broadcast through the large transmitters.

Contribution of Women to Radio Styles

UNTIL about three years ago, radio was strictly a man's affair, in the estimation of Bertha Brainard, manager of WJZ. "It failed to appeal greatly to women," she said. "A large percentage of the sets in use were home-built. They were complicated in operation and difficult to keep in working order. Consequently, women were not attracted to broadcasting.

"In most homes the set had been bought or built by the men of the household, who had become interested in radio as a mechanical proposition. Broadcasting was not such an important factor in radio as it is today. The programs which were received were of secondary consideration to the fact that the receiving apparatus would bring in something. The lure of radio was largely mechanical, and mechanics have never carried a large appeal for women in general.

"Then, too, a great many of the receivers of that day were not equipped for loudspeaker operation. One pair of headphones seemed to provide entertainment for every member of the household who wanted to listen. When broadcasting began making its greatest strides, women were slow to become acquainted with the fact, because comparatively few of them had ever bothered to listen in.

"In those days, women looked on radio as something that occupied the entire attention of the men of the family while they were at home and kept them up until all hours of the night, making them cross and irritable the next day.

"More than that, most of the home-built sets were unattractive and notable chiefly as dust-catchers. Men for some strange reason rose in wrath when their wives, while dusting their sets, happened to disturb the battery leads, with the result that the tubes mysteriously refused to light the next time that the receiving set was used.

"All of these factors added to the fact that some storage batteries, when carelessly handled, had been known to display a rather remarkable appetite for expensive rugs, tended to make most women antagonistic to radio.

"Then, practically simultaneously, broadcasting began to improve and radio receivers began to lose their objectionable aspects for women—and I firmly believe that the women themselves were responsible, in one way or another, for both of these changes."

Underwood & Underwood

This newly developed photo-radio machine receives and displays the drawings and photographs of the latest fashions as they are flashed across the Atlantic from Paris

Applied Science for the Amateur

A Department Devoted to the Presentation of Useful Ideas. Material of Value to All Will Be Found Here

CONDUCTED BY A. P. PECK

A Simulated "Aura"

AN interesting effect in trick photography is illustrated in these columns. The young lady appears to be surrounded by an aura, but in reality, there is only an out-of-focus automobile headlight placed on the opposite side of her from the camera. Between the light and the girl is placed a translucent screen. With this method, and variations of it that will suggest themselves, any amateur photographer will be able to obtain some startling results.

An out-of-focus automobile headlight helped to produce this effect

An Indoor Model Tractor 'Plane

FROM the number of inquiries received to date regarding the places where parts for model airplanes may be obtained, it is obvious that many of our readers are interested in this instructive sport. Below we present the third of a series of short articles on the construction of model airplanes, this time giving the details of a rubber-band propelled type suitable for indoor flying. Other more elaborate models will be detailed in future issues.

THE following materials are necessary: one piece of balsa wood 15 inches by one fourth of an inch by three thirty-seconds of an inch; two pieces of balsa wood 16 inches by one eighth of an inch square; one balsa propeller blank 10 inches by one and three eighths inches by eleven sixteenths of an inch; five pieces of bamboo three inches by one thirty-second of an inch by one sixty-fourth of an inch; one piece of bamboo five inches by one eighth of an inch by one sixteenth of an inch; one piece of bamboo 13 inches by one thirty-second of an inch square; one piece of bamboo six inches by one thirty-second of an inch by one sixty-fourth of an inch; one sheet of Japanese tissue paper 20 by 12 inches; one propeller nail bearing; one propeller shaft and two washers; two cans or rubber guides; two wing clips; one rear hook; 32 inches of one eighth inch flat rubber thread; silk thread; banana oil, and ambroid.

The motor stick shown in the center of the drawing is made from the 15-inch length of balsa wood. This piece, when finished, is one fourth of an inch wide in the center and tapers to five thirty-seconds of an inch square at the ends. When dressed to size, it should be given a coat of banana oil to stiffen it. The propeller bearing is made by hammering and bending a small nail. A small hole to accommodate the propeller shaft is drilled in the front end and the bearing is bound to the front of the motor stick. The two cans are bound in place on each side of the center and the rear hook is bound to the rear end.

The rudder is made from the long piece of bamboo and bent into the shape shown in the drawing. The turns can be made easily by holding the section to be bent over a candle flame and when the wood becomes heated it can be formed into the shape shown. It will be noticed that the base of the rudder is extended beyond the upright portion and bound to the motor stick under the rear hook.

Ambroid should be used on all of the wrappings and joints. When using ambroid, coat each of the pieces to be joined and let them dry. Then apply a second coat, allowing the cement to set. To cover the rudder, give the frame a coat of banana oil and lay a piece of Japanese tissue paper over the frame. Press the paper against the frame so that it will adhere, and when it is dry trim off the excess paper with a razor blade.

The horizontal stabilizer is made by ambroiding the six-inch length of bamboo to the under side of the motor stick one inch from the rear. The center of a piece of silk thread a foot and a half long is tied to the base of the rudder at a point one inch from the end of the motor stick. The two ends are then carried around opposite ends of the bamboo tail piece and fastened to the motor stick three inches in front of the bamboo piece. A touch of ambroid should be given where the thread passes the bamboo stick and where it is tied.

When the tail frame has set, it should be covered on the under side with a piece of Japanese tissue paper in a similar manner to that employed for the rudder. In trimming the paper, however, one sixteenth of an inch margin outside of the thread should be left in order to avoid cutting the thread when trimming.

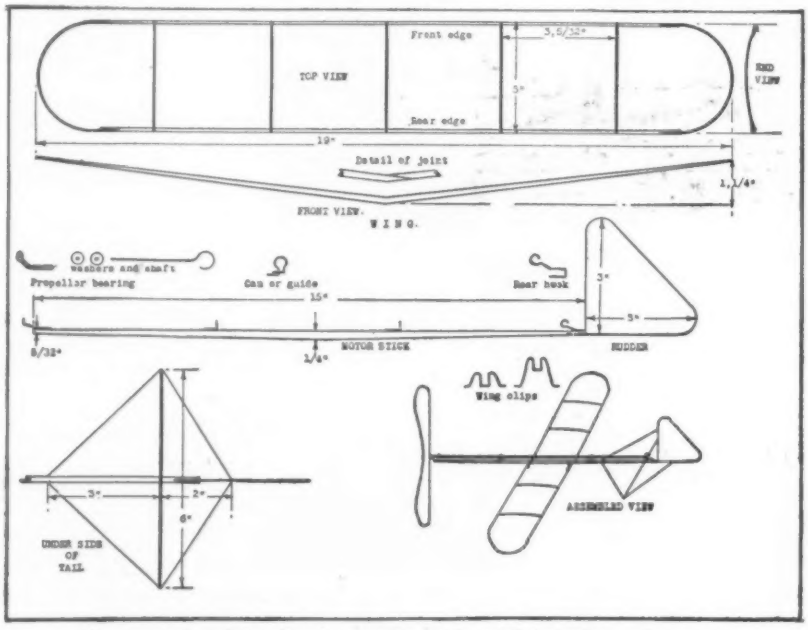
To form the wing, the two 16-inch pieces of balsa are given a slanting cut in the center and rejoined as shown in the detail view, thus forming a slight upward angle. The three-inch lengths of bamboo which are to be the ribs are slightly heated and curved as shown in the end view. The end of each rib is then split for a short distance and fastened to the front and rear wing edges. Ambroid should be employed in this joint. When this ladder-like frame is completed, the unused pieces of bamboo remaining should be bent into a semi-circle of three-inch diameter and carefully split in half, making two ends of the same shape. These should be ambroided in each end of the wing frame and, in order that the edges of the wing may be a continuous line, a slight recess is cut into the ends of the balsa pieces.

Before covering the wing frame, two wing clips are made to the shape shown in the detailed drawing near the assembled view. The center section of these wing clips, which are made from small piano wire, should be of such size that it will grip the motor stick. This gripping should not be so tight that it will injure the motor stick nor so loose that it will not be a strong support. In the right-hand clip, the distance between the bottom of the stick portion and the bottom of the two legs should be seven sixteenths of an inch. The left-hand wing clip is bound and ambroided to the front spar of the wing and the right-hand clip is similarly fastened to the rear spar in the center.

The wing can now be covered. This is

the most important covering job on the model, and if the tissue paper is wrinkled, it should be pressed with a warm flat-iron before applying. The section of paper between the two wing clips can be cut to fit but the rest of the paper can be left overlarge and trimmed after the banana oil has set. In covering this wing, proceed from the center, doing one section at a time, making sure that the tissue paper is pulled tightly so that the finished job will be unwrinkled.

The propeller is carved from the balsa blank in the manner explained in our December issue. The propeller shaft is made from piano wire and two washers are used



Constructional details of an easily made model airplane. See text

on the shaft between the bearing and the propeller to cut down the friction. The length of rubber thread is tied in a loop, using a square knot, and strung on the model between the two hooks and through the two rubber guides. To assemble the model, the wing should be fastened on the under side of the motor stick by placing the stick in the two clips. Because the rear clip is higher than the front one, the wing is placed at the angle, which is necessary for proper lift.

To fly the model, wind the propeller in the opposite direction to that intended for flight, turning it several hundred times until the rubber thread is tightly twisted. To launch, hold the propeller with one hand and the model in the center with the other hand, and cast it gently forward. If the 'plane climbs too steeply, the wing should be set back or adjusted to have a less angle of inclination. It it noses down, the wing can be set forward or inclined steeper. When the right place for the wing has been found, it should be marked so that the model can always be properly adjusted.

If properly made with careful attention to having all parts true and accurate and if the model is correctly adjusted, it should fly for at least a minute. Models of this same design have flown for two and three minutes. When flying indoors, the rudder should be bent by first breathing upon it and then bending it slightly, holding it until the heat generated by the breath has cooled, when the rudder will remain slightly curved.

Unscrewing Rusted Threads

THE time-honored directions for loosening rusted bolt and pipe threads are, "Drench with kerosene and hammer well—." If that does not work, then try gasoline instead of kerosene, gasoline being far more penetrating, says James F. Hobart, writing in *Power*. Bolts and pipes that are portable may be successfully treated by heating them in a blacksmith's forge fire, then hammering the nuts or fittings well and unscrewing them while hot. It may be well to wind a wet rag around the pipe close to the fitting, before applying the pipe tongs or wrench. In case the pipe appears to be weak and is dented by the tongs, apply less force to the tongs, but put on two or three pairs and thus distribute the pressure upon the pipe to a value where the metal will not be damaged.

When the pipe and fittings are stationary and cannot be taken to a forge or boiler furnace, one to three blow torches may be used with good effect. The direct application of a blow torch to a small nut or fitting will usually loosen the rust and permit of its being unscrewed. If this treatment fails, procure some charcoal and make a hole in a large piece in such a manner that the charcoal may be placed closely around the bolt or fitting that is to be loosened. If no charcoal is available, bore a hole in a piece of board or plank just large enough to pass easily over the nut or fitting. Then apply one or two blow torches to the nut, and in a short time almost a red heat will be obtained and the rust will be thoroughly broken.

Large fittings may require a little more wood or charcoal. Perhaps pieces of wood or coal may have to be piled all over and two or three blow torches used in the heating. For large fittings it may be necessary to have still more heat than two blow torches and the wood can furnish. In such cases procure a third torch and pump it up, but do not light it. When the charcoal or wood becomes burned and more heat is needed, then open slightly the gasoline valve of the pumped-up but not lighted torch, and throw a thin stream of gasoline into the wood or coal, at the point where more heating power is required. Fittings on 12-inch pipe may be heated almost to a red heat in this way. Be sure that a clean stream of gasoline is thrown by the unlighted torch. It may be necessary to remove a bit of scale or carbon from the nozzle of the blow torch in order to make it throw a clean stream.

If compressed air is available, throw some ignited oily waste upon the rusty fitting, pile on a little wood, place the nozzle of an air hose to play upon the fire, then pile on more wood, charcoal or bituminous coal, and in a short time the rusty fitting will be heated and the pipe can be backed out of its fittings or twisted in two.

When compressed air is not available, a small pipe may be run from the blower of a smith's forge, or from a blower or exhaust fan in the plant. The writer has used an ordinary desk ventilating fan to furnish blast for a soft-coal fire around a rusty pipe fitting. Should the pipe be in position above the floor, suspend a piece of sheet iron or a wide plank under the rusty fitting, put sand and bricks upon the plank, build loose brick side walls to hold the soft coal in place, then heat the fitting in the oven built around it.

Different conditions will require different treatment, but the foregoing suggestions should take care of most cases found in practice.

More Photomicrography

IN our July issue, we published in this department an article on photomicrography. Many of our readers have expressed their interest in this subject, so it is with pleasure that we present another short article by the author of the first one. In this, which is printed below, he goes into the subject of dyes and color filters. Some more of the photomicrographs which he has taken are reproduced in these columns. *The Editor.*

In the last few weeks I have taken a number of photomicrographs with the aid of a set of light filters. As a result, I find I am able to photograph a wider range of objects—where color is concerned—and where color is not concerned, I am able to get better resolution.

The set of filters which I used is known as the Wratten "M" filters, and consists of nine units which are lettered as follows:

"A" (Orange-Red)
"B" (Green)
"C" (Blue-Violet)
"D" (Purple)
"E" (Orange)
"F" (Red)
"G" (Dark Yellow)
"H" (Blue)
"K'" (Pale Yellow)

Each filter consists of a square piece of gelatine two inches in diameter. I found that they can be conveniently placed in the sub-stage condenser ring "as is," or they may be trimmed down a bit. Unless they are cemented between glass, it is best to handle them with forceps, and then only on the edge. Three of these filters are of no use whatever, namely, "A," "E," and "F." "A" transmits only orange-red light. "E" transmits only orange light, and "F" transmits only red light. Ordinary film is

(*Continued on page 75*)

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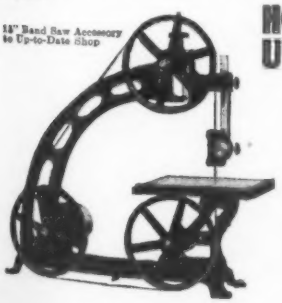

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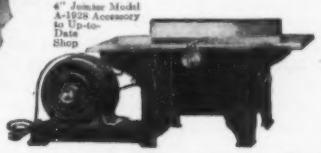

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CONDUCTED BY D. H. KILLEFFER

A New Lead Hazard

SILK has been given body and weight by the addition of harmless tin salts for years, but now a new potential hazard to health is seen in the substitution of cheaper lead for tin in this connection. On this subject, *Industrial and Engineering Chemistry* says editorially:

"Lead costs approximately one-tenth as much as tin, and this has been a factor in the adoption of a method for the weighting of silk in which tin-lead phosphate is the raw material rather than tin tetrachloride. The lead becomes fixed in the fiber as lead oxide, lead phosphate, or some combination of the two. Besides being a much cheaper process, silk weighted with lead salts seems to deteriorate more slowly than silk weighted with tin. There are some disadvantages. For instance, some of the lead is extracted in the benzene baths used by dry-cleaners and is ready to combine with the sulfur which may be brought into the baths in wool. The dry-cleaners have already had some difficulty, since they are not familiar with all the characteristics of the garments they treat; an occasional white-flannel suit has been both cleaned and turned gray in one operation. Lead-weighted fabrics are also sensitive to the hydrogen sulfide in the air and the lighter shades turn dark on exposure and may eventually turn almost black. Fancy what comments may be made concerning the dye and the dyer when this takes place, and think how many laundry owners and dry-cleaners, without a chemist to make an adequate defense, will make settlement for damage laid to them rather than risk the anger of a dissatisfied customer! It is doubtful whether the real culprit will be apprehended and trouble is made all along the line because some one for an initial price advantage, puts a process into practice without giving thought to all the ills that may be involved.

"Although scientists generally agree that lead poisoning is due more to inhalation or ingestion of lead dusts, cases of poisoning from the free application of lead plaster have been reported. Much of the lead-weighted silk finds its way into commerce in underwear and it is a question whether lead in silk on coming into contact with the various secretions of the skin might not be absorbed to some extent, for it is found that such silk treated with 3 percent acetic acid at body temperature does lose some of the weighting material. It must also be remembered that lead is a cumulative poison and, while the hazard may be slight, it still seems that individuals who might question the desirability of wearing a lead-weighted garment should be given the facts and allowed to make the decision for themselves.

"At first thought this would seem to be a problem for the Public Health authorities, but it is hardly fair to ask the public to pay for an investigation, the outcome of which concerns first and foremost those engaged in the business of weighting silks. The public is not endangered by tin-weighted silks, and it seems clear to us that if such investigations were to be made, some other than the public treasury should bear the expense. The difficulty of the problem is apparent, for all silks are not weighted to the same degree. They are not subjected to the same number or kinds of laundering operations, are not worn for equal periods of time or under the same conditions by various individuals and, what is even more disconcerting, individual idiosyncrasies must be taken into consideration.

"Speaking for ourselves, if we must have weighted silks, we prefer a tin shirt to a lead one, and we think our fellow sufferers should be given the information and the opportunity to choose for themselves. In particular, we protest the unnecessary exposure of the general public to a potential hazard, the existence of which is not dictated by any major or fundamental consideration."

Wood Pulp Shot from Guns

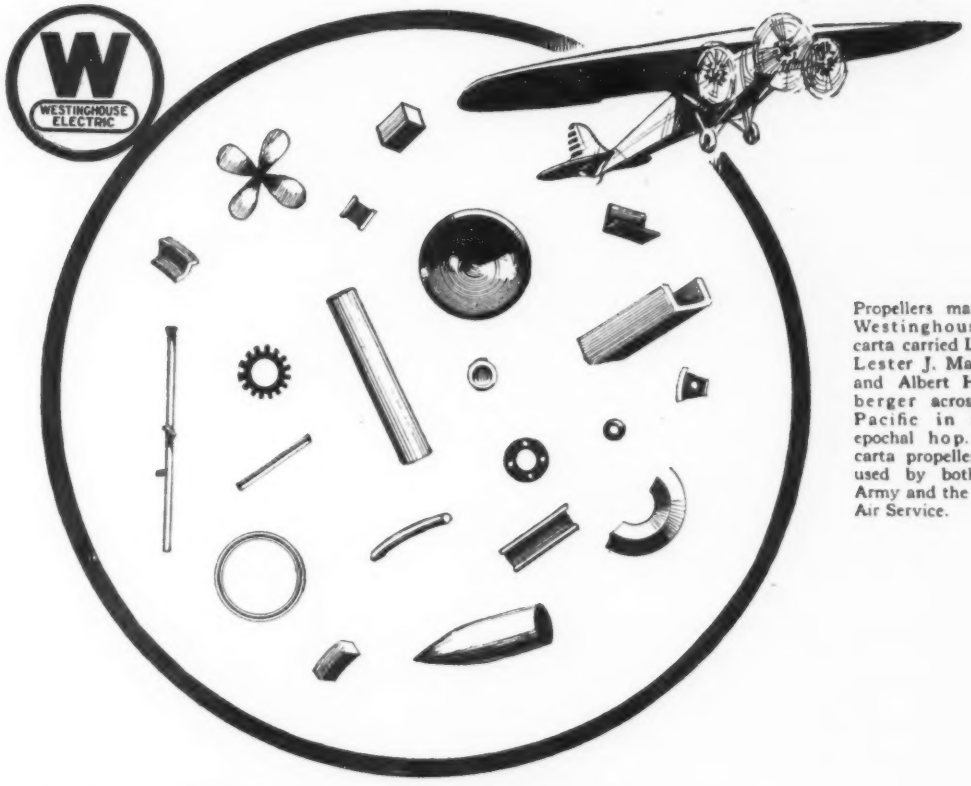
EVERYONE has heard of the food that has been "shot from guns" but the latest application of a similar process to the manufacture of wood pulp from sawmill wastes opens up new possibilities both in the recovery of value from wood refuse and in the manufacture of pulp products. The process devised and operated by William H. Mason in Mississippi is described in a recent issue of *Chemical and Metallurgical Engineering* by S. D. Kirkpatrick.

The treatment of saw-mill waste consists in chipping it, enclosing the chips in a tight cylinder where they are heated by steam at 1200 pounds pressure and suddenly disintegrated. The steam-exploded fibers possess desirable insulating characteristics when pressed by hydraulic presses into a wood-like board. In describing the process, Mr. Kirkpatrick says:

"About 200 pounds of the green chips are charged into one of the three guns, the valve is closed, and for 10 to 15 seconds the chips are steamed at a pressure of about 200 pounds. The lignins of the wood are thus softened and then steam at the full pressure of 1000 pounds is turned on for an additional three to five seconds. Next the operator throws the lever that operates the hydraulic discharge valve and the chips are literally shot out of the gun, exploding into moss-like fibers as they shoot past the ports at an estimated velocity of 4000 feet per second. This is sufficient, of course, to carry the fiber and steam into the cyclone separator where the steam escapes to the atmosphere and the fibers drop back into the wooden stock chest.

"After the fibers have cooled somewhat, water is added and the mass is forced through the refining machines. The fiber is first formed into a sheet about two inches thick, but on passing through the press rolls, this is reduced to about three quarters of an inch in thickness. An automatic cutting device cuts the sheets into 12-foot lengths and these are ingeniously loaded on portable racks, each of which holds 20 sheets or approximately 1000 square feet.

"These racks, which are on a narrow-gage track, are then wheeled to the hydraulic presses and the wet sheets, supported on ordinary window screen wire, are drawn in between the steam-heated platens and the press is closed. A pressure of about



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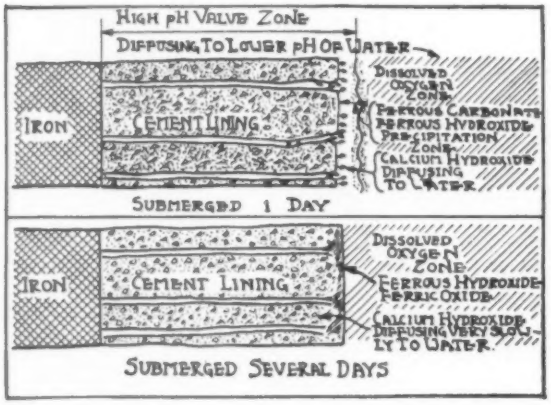
Protecting Water Mains with Cement Linings

CEMENT linings have been proposed and are now in use for the protection of iron pipe from corrosion by the water it carries. Harry Y. Carson, of the American Cast Iron Pipe Company, has made a study of the way in which cement protects iron and in reporting his investigation to a recent meeting of the American Chemical Society, said:

"As a convenient way of considering the manner in which cement protects the inside of cast-iron mains and other submerged iron surfaces, the accompanying figure represents the connecting pores that exist in the cement as continuous capillaries running from the water surface of the cement lining to the iron surface. For convenience, we may consider these capillaries as being straight tubes of extremely small diameter, although not necessarily of uniform bore. The calcium hydroxide in the especially applied cement lining is capable of raising the entrapped water within the capillary tubes to a high alkalinity. If pipe that has been properly cement-lined is put into service and the inside surfaces of the pipe are saturated with water, there is a diffusion of calcium hydroxide to the flowing water which is on the outside of the lining. This accounts for a constant lowering of the alkalinity of the cement. The dissolved iron in the flowing water, however, is precipitated in the form of iron hydroxide as soon as it reaches a zone where the alkalinity is sufficiently high to flocculate the iron hydroxide, and a dense mixture of iron hydroxide is formed at the outside ends of the capillaries in the cement.

"It is generally recognized that a thin coating of cement placed on iron surfaces and exposed to ordinary atmospheric conditions does not protect the iron from corrosion in the same manner as it does when submerged under water. This fact can undoubtedly be explained by the different mechanisms under atmospheric conditions and under submerged conditions. In the atmosphere, the products of corrosion are formed immediately adjacent to the body of iron, because there is no chance for the iron to be carried any distance from that surface by going into solution as is the case in underwater corrosion, where tubercles are formed. Hence in the case of atmospheric corrosion, a cement coating on iron is flaked or spalled off by physical expansion of the products of corrosion."



When iron pipe is employed for carrying water, corrosion is set up which is undesirable for many reasons. If, however, the pipe is lined with cement in the manner illustrated, the pipe is protected for the reasons detailed in these columns

Tear Gas, a Life Saver

A SERIOUS mistake was made in the failure to use harmless tear gases during the early days of the present disturbances in China, according to the following editorial in *Industrial and Engineering Chemistry:*

"Instead of controlling mobs and effectively chastising that part of the Chinese population which sought to do violence to foreigners, those in command chose to use shot and shell. The result is a number of dead and wounded, the sacrifice of practically all the good results achieved through constructive work over several decades, and the laying of a foundation for revenge and hatred which will handicap even the most unselfish work which the white race may undertake in China for years to come.

"Why are such blunders continually repeated? Tear gas has been shown to inflict no injury. Its manufacture and use are well known. Its efficiency in producing both physical and psychological effects has been demonstrated. It is difficult to see why, with all our talk of humanitarianism, when the crucial moment arrives we choose to kill and weep afterward, rather than to cause weeping first with its consequent diversion of attention and effort. Our sentimentalists seem to prefer to weep at the prospect of nontoxic tear gas rather than over gunshot casualties. There is little excuse for failure to have used tear gas in China. It may still be employed effectively, but powder and steel have already wrought much permanent damage."

Synthetic Petroleum from Coal

COAL, a basic material for chemical industry, will play a very important role in obtaining liquid motor fuels in those countries having no deposits of oil, according to Dr. Hans Tropsch of the Kaiser Wilhelm Institute at Mulheim-Ruhr, Germany, in addressing the Institute of Chemistry of the American Chemical Society on "Problems in the Chemistry of Coal" recently.

"From an economical standpoint, the chemical utilization of coal is to be welcomed for it heightens its intrinsic value and so has a direct relation to the enrichment of the common wealth of nations," Dr. Tropsch said. "In Germany today the problem of transforming coal into oil is being intensively studied," the speaker continued. "The goal is to be reached by two different roads: through the direct hydrogenation of coal, as it is carried out by Bergius and lately by the I. G. Farbenindustrie, or, catalytically from water gas, a process that Franz Fischer and I have worked out successfully at the Kaiser Wilhelm Institute for Research in Coal at Mulheim-Ruhr. All the products of natural petroleum have thus been made in great purity.

"The decomposition of coal solely by heat at low or high temperature to make coke or smokeless domestic fuel yields a series of chemically valuable liquid substances, but their quantities are generally small in comparison with the amount of coal used. In their production we are limited first of all by the possibility of marketing the principal product, in this case coke.

"For economic reasons, therefore, the quantities of the by-products which are valuable in and for themselves can not be increased at will. It is important for the economic success of the distillation that the semi-coke, the principal product of the process, be obtained in dense lumps suitable for transporting and storing. A distillation of soft coal for the sake of the oil alone has little prospect of being economically successful.

"The first experiments in hydrogenation of coal to convert it to a liquid by a method which could be transferred to large scale operation were carried out in 1913 by Bergius and Billwiller who allowed hydrogen to act upon finely pulverized coal at temperatures of about 450 degrees and pressures of several thousand pounds per square inch. Even in their first patent they state that they can convert 85 percent of the coal to liquid, soluble, or gaseous compounds.

"Numerous experiments have been made by Bergius himself, as well as by other investigators, concerning the treatment of coal with hydrogen under pressure. They are most easily hydrogenized and give the highest yields of oil. In the Bergius process the consumption of hydrogen amounts to about 5 percent of the weight of the coal or 17,000 cubic feet per ton of coal.

"By varying the hydrogen pressure, the velocity of flow, and particularly by the use of certain catalysts, it is said to be possible to obtain the predominance of certain reaction products, particularly low-boiling hydrocarbons. Now it is possible, by the choice of certain catalysts, to direct the reaction along definite paths so as to get hydrocarbons similar to those in either petroleum or coal tar or mixtures of both and thus obtain anti-knock motor fuel directly. The most essential factor is the obtaining of cheap hydrogen.

"There are, too, unsuspected possibilities in the chemical conversion of the water gas obtainable from coke. Work done within the last few years has shown that the most different organic compounds can be manufactured in this way, methanol, synthol, hydrocarbons, et cetera. We are not restricted, in this synthesis, to any definite coal but it is possible to employ other carbonaceous substances as raw materials providing water gas can be obtained from them.

"Thus for example, it is possible to use poorer grades of fuel, anthracite coal, and

(*Continued on page* 84)

"Watch your ~~step~~ throat"

Due to overheated homes, stuffy offices, crowded cars, sudden changes of temperature, and exposure to bad weather, you are in constant risk of colds, sore throat—or worse.

You can reduce this risk considerably if you care to. Every night when you get home, gargle with Listerine used full strength.

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It may be, and very probably will be, the means of sparing you a long and trying siege of illness. Lambert Pharmacal Co., St. Louis, Mo., U. S. A.

Gargle when you get home

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and nose more than
50 diseases
have their beginning or development. Some, of mild character, yield to an antiseptic. Others, more serious, do not. At the first sign of an irritated throat, gargle frequently with Listerine, and if no improvement is shown, consult a physician.
Watch your throat!
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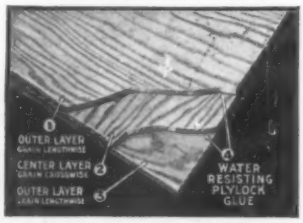

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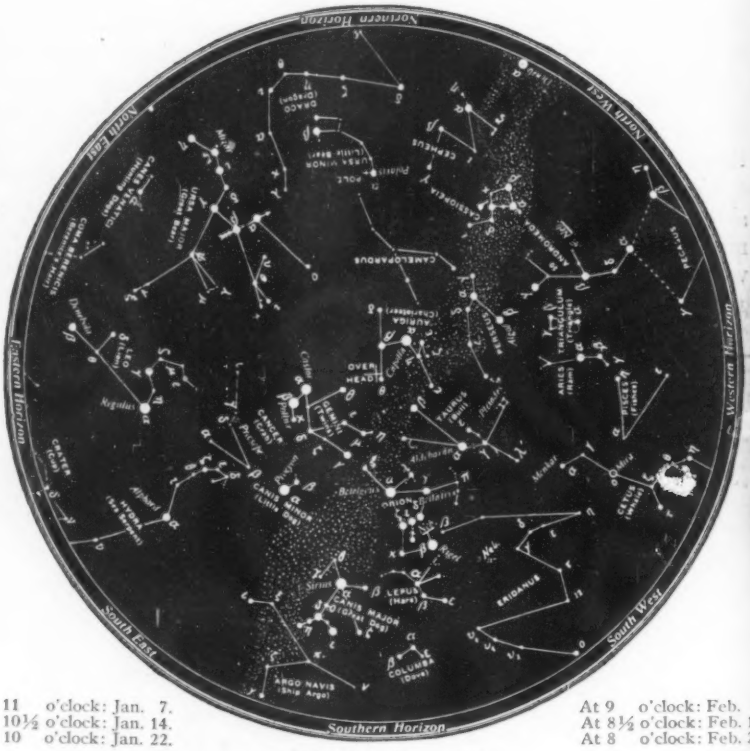
The Heavens in January

By PROF. HENRY NORRIS RUSSELL, Ph.D



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: January 29.

NIGHT SKY: JANUARY AND FEBRUARY

The Heavens

Orion is now in his glory high in the south. The great nebula of which we have spoken is easily visible—the middle one of the row of three stars just below the belt of Orion. Its hazy light is visible even to the naked eye, and is clearly to be seen with a field glass—although a telescope is needed to bring out the characteristic greenish color.

Below Orion we find Sirius, brightest of the stars, and if we are in the Carolinas or farther south, Canopus, low on the horizon. High above, Auriga, Gemini and Taurus surround the zenith. Canis Major and Hydra are in the southeast; Leo in the east, Ursa Major in the northeast. Draco and Ursa Minor in the north, Cassiopeia in the northwest, and Cetus and Eridanus in the southwest.

The Planets

Mercury is in conjunction with the Sun on the 8th, and is visible only as an evening star, low in the sunset, at the end of the month.

Venus rises about 4:30 A.M. and is very conspicuous in the early morning.

Jupiter sets near 10:30 P.M. and counts as an evening star.

Saturn is a morning star and is in conjunction with Venus on the 16th, the two planets being but half a degree apart.

Uranus is in Pisces and may be observed in the morning hours. On the 23rd he is in conjunction with Jupiter and half a degree north of him.

Neptune is in Leo, close to the bright star Regulus. On the 9th he passes directly north of the latter, at a distance of a little less than four minutes, so that the two will be in the same low-power field. At this time the planet is moving one minute westward and four tenths of a minute northward per day. This affords a chance for the amateur to identify this faint planet. Even a very small telescope should show the little pin point of light near the great star, and sketches made a couple of days apart should reveal the motion.

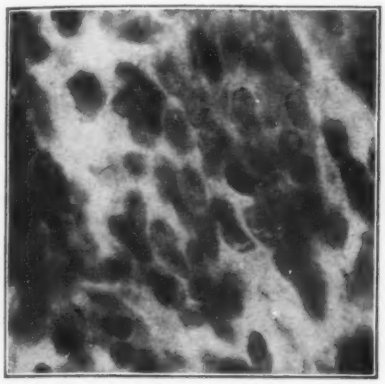
Even with a large telescope no markings may be seen on Neptune's disk and there is no direct evidence concerning its rotation. Neptune's distance from the Sun is 2,792,700,000 miles. He moves in his orbit at the rate of only about three and one third miles per second and it requires 164.8 years to complete a circuit of the orbit. His mass is over 17 times that of the earth, his density being 1.6. Neptune was originally discovered "mathematically," as it were, both Adams and Leverrier having deduced his existence from observed perturbations of the planet Uranus.

The Moon is full at 1:00 A.M. on the 7th, in her last quarter at 4:00 P.M. on the 14th, new at 3:00 P.M. on the 22nd, and in her first quarter at 2:00 P.M. on the 29th. She is nearest the Earth on the 3rd, farthest off on the 15th, and nearest again on the 29th. During the month she passes Neptune on the 10th (which will rather spoil the chance to see the planet when closest to Regulus), near Saturn and Venus on the 19th, Mars on the 20th, Mercury on the 23rd and near Jupiter and Uranus on the 26th.

Applied Science for the Amateur

(Continued from page 68)

not sensitive to orange and red light; however, the microscopist may purchase panchromatic cut film, which is sensitive to all colors. I do not think that this is absolutely essential, except where it is desired to make red photograph as white, and usually the microscopist wants just the opposite. If a section or object is not stained too deep red, it will not photograph



Glia cells in medulla oblongata. Blue stain used. x918. "B" filter. Exposure 30 seconds

black. The print will show the section or object as light gray, no filter being necessary.

A set of these filters may be purchased for $2.50, or they may be procured singly for 40 cents apiece.

The following is an account of the filter or filters that may be used to advantage to photograph certain colors:

To photograph blue objects: For this class of objects, three filters may be used,

Staphylococci from the teeth. Light blue stain used. x950. Exposure of 30 seconds. Filters employed were "G" and "K2"

according to the degree of contrast desired. (If no filter is used to photograph an object which has been stained blue, like a bacterium, the result will be a fade-out.) If a photograph is to be taken of a bacterium, it will be desirable that it stand out sharply, (maximum contrast). Therefore use the "G" filter, or "B" and "G" combined. If a photograph is to be taken of a section,

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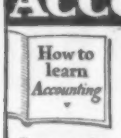

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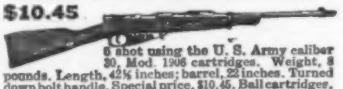

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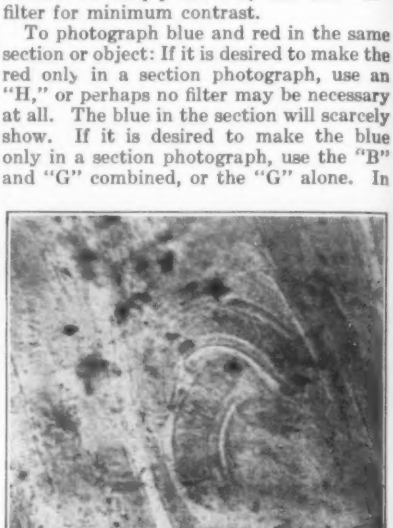
detail must be obtained, (minimum or medium contrast), then the "B" filter will do very well for medium contrast. If the section be deeply stained, use the "H" filter for minimum contrast.

To photograph blue and red in the same section or object: If it is desired to make the red only in a section photograph, use an "H," or perhaps no filter may be necessary at all. The blue in the section will scarcely show. If it is desired to make the blue only in a section photograph, use the "B" and "G" combined, or the "G" alone. In



Trichina in flesh, stained red. Exposure was only 15 seconds and no filter at all was used

this case, however, the red will not be eliminated (the blue and red will photograph equally) as well as the blue was eliminated in the preceding case. If panchromatic film were used in this instance, the red could be made to photograph as white, and the blue, dark—using the "A" or "F" filter. Of course, the detail in the red will always show in this instance.

To photograph red objects: If a photograph is to be taken of a bacterium, photograph for maximum contrast, using the "B" filter. If it is desired to have only the

Bacteria in an epithelial cell from the interior of the mouth. Stained blue, x950. "B" and "G" filters, with an exposure of 30 seconds

detail in an object or section show, (minimum contrast) the "G" filter will do all that can be done if ordinary film is used. This really amounts to medium contrast. With panchromatic film and the "F" filter, detail is brought out perfectly.

To photograph brown objects: For maximum contrast use the "H" filter. For minimum contrast use the "G" filter. For medium contrast use the "B" filter.

To photograph diatoms, et cetera where resolution is desired, use the "D" filter. "C" is next best.

Concerning exposure of film when filters are used: I find it is not necessary to expose the film more than one minute—usually 30 seconds suffices—even with the highest magnifications, (1500x) providing the height of the camera is not more than 15 centimeters, and a 100-watt lamp is used.

I think it is very advisable for the microscopist to make a simple box camera 25 centimeters (10 inches) high. Then the photograph will magnify the microscope magnification. It will not be necessary to force the microscope magnification to 2500x in order to get a photograph of x1500, as is the case when a camera 15 centimeters high is used.

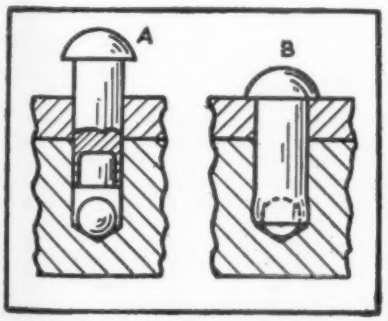
If the entire photographic apparatus (excluding the lamp) is placed on a soft pillow, vibration will not be found troublesome, providing the microscope is fairly heavy, and the stand rigid. A rubber band snapped over the camera may also help, although I take most of my photographs without the pillow and rubber band, preferring to sit on the former article.

Contributed by A. C. Lonert.

Riveting in Blind Holes

IN a recent issue of *English and Amateur Mechanics*, appears the following interesting item on the fixing of tubular rivets, or those made as described, in blind holes in castings and the like.

It is often required to rivet a plate or other object to a thick piece of metal, which cannot conveniently be drilled right through, for a bolt or rivet. In some cases also one cannot get at the other side of the thicker metal object to rivet the end over or to insert the rivet. In such cases a very convenient



A simple method of clinching rivets in blind holes. See text

method is that shown in the above illustration. All that is necessary is to drill a hole equal in depth to about two or three times the diameter of the rivet with an ordinary drill.

The special rivet employed is readily made by holding the rivet in a lathe chuck or in a jig attached to the drilling machine table, and drilling out a hole to about the same depth as the rivet diameter, leaving a substantial shell of metal around the hole. An ordinary ball bearing of an appropriate size—usually one millimeter more than the diameter of the hole in rivet—is dropped into the hole as shown in A, and the rivet head is hammered down, as in B.

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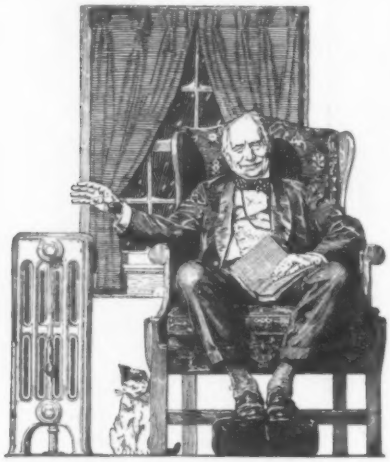

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Partners Make Telescope

MR. J. A. EMMETT, a sheet metal worker, and Mr. J. T. Chesley, assistant cashier of the Perry National Bank, Hamilton, Texas, have completed, in astronomical partnership, two reflecting telescopes, one of which is illustrated in these columns. Two men working together can accomplish a disproportionate amount of handiwork, and get a lot more fun out of it, than one. For one thing, this provides someone to talk to—someone that understands better, for example, than one's wife, the peculiar dialect of the average telescope enthusiast. The joint letter of the Chesley-Emmett amateur "firm" follows:

Telescope Editor,
SCIENTIFIC AMERICAN:

We wish to apologize for having delayed so long in thanking you for showing us the way to many pleasant hours of work and observation. Within the last few months we have completed our second telescope, principally following the instructions contained in your book, "Amateur Telescope Making." Both instruments are giving excellent results. Our first telescope, having six-inch mirror of 45-inch focal length, was finished about a year ago. We were more ambitious in our second attempt.

The mirror is 10 inches in diameter and has a focal length of 83 inches, and the mounting is of the fixed eyepiece type. A complete Ford front hub, for which a shaft of sufficient strength to carry the weight was turned in a lathe, forms the polar axis. The declination axis is made from an extra thick steel tube and a two-inch cross which carries the eyepiece and an adjustable slip-in prism holder. Slow motion in declination and right ascension is controlled through 96-to-one worm gears, and both axes are equipped with setting circles. The combined weight of the mounting, counter-weight, and mirror is approximately 150 pounds.

In order to secure a clear horizon, this telescope is mounted on a high point near town, and the mirror, when not in use, is kept dry over calcium chloride in a metal box built into the observation stand.

The experience gained in making the six-inch mirror was of inestimable value to us in completing the 10-inch. The smaller mirror required about 80 hours of work and has none too good a figure, while the larger was ground, polished, and parabolized in about 35 hours.

J. A. Emmett,
J. T. Chesley.

Speaking of the Weather

SEVERAL months ago, we published a little item called "Weather," in which we deplored the lack of data supplied by ships in the Atlantic Ocean to the Weather Bureau. It evoked the following protest

Messrs. Emmett and Chesley with their ten-inch reflecting telescope made according to instructions given in "Amateur Telescope Making"

from Sidney N. Stribling, an officer of the *S. A. Perkins:*

"I am very much surprised at your article 'Weather' appearing several months ago in the SCIENTIFIC AMERICAN.

"Since I have been sailing as an officer in the Merchant Marine I have made many reports, weather and others, to the government, and I make constant use of the valuable bulletins and other publications issued by the Hydrographic Office. These publications, I believe you will find, are to a large extent, reliant upon the reports made by marine officers all over the world, and reflect the interest taken by them in the subject. Quite a lively interest is taken in the weather of the North Pacific Ocean, and every ship on the route makes a report at a certain time each day. I consider myself under obligation to make report of anything unusual and

Details of axes and slow motions of the home-made telescope described on the opposite page

I believe this to be a common feeling aboard any ship.

"About securing reports from the transatlantic ships, I think I can speak for them all, and say that all you have to do is to ask them to make the reports."

The best authority on what reports the Weather Bureau gets is the Weather Bureau itself. We based our items on the statement of Charles L. Mitchell, the Bureau's chief forecaster. His exact words were:

"Ships at sea report to us only voluntarily. Unless some special arrangement is made with them we get absolutely no reports from the North Atlantic. We get ample reports from the Pacific and from the Caribbean, because ships in those waters do not have much radio business. Transatlantic vessels have so many passengers who want to send radio messages that they do not take the time to send weather reports."

Do you recall the ill-fated Sikorsky airplane whose pilot, Captain Rene Fonck, had planned to fly to Europe? He went to

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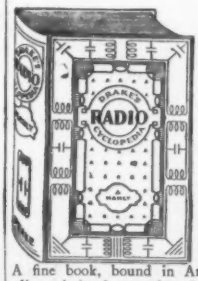

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Washington and made arrangements to get forecasts from the Weather Bureau, promising in return that he would arrange with ship captains all along the route to radio existing weather conditions to the Bureau. No reports were received from ships at sea and it was impossible to make any estimate of the weather other than that prevailing off the Atlantic Coast.

Do you recall the disastrous Florida hurricane? On the morning of September 17, a British cable message told of the blow at Turk's Island. No further news of the storm's direction was received until the hurricane hit the Florida coast on September 18.

> "We have to issue forecasts twice a day, whether we get any advice from certain areas or not," Mr. Mitchell said on that occasion. "We had to issue hurricane warnings along the Florida coast last night, although we had no information where the storm was after it hit Turk's Island. And we are expected to tell what the weather will be the entire distance across the Atlantic Ocean without having any word from the ships along the route."

Conditions would be ideal if only the Atlantic mariners were as conscientious as are the men of the Pacific where Mr. Stribling is most at home. Fortunately, however, Atlantic weather is not so important as Pacific weather, because in the Pacific the storms are coming towards the United States, while storms in Atlantic waters are going away from us. The Bureau is interested chiefly in storms which are heading our way, so that it may warn shipping and towns in the path of the storm.

Our Error

LONG ago someone said, "Erasers are put on pencils because we are all human; we cannot help making mistakes sometimes." The following letter from a reader who lives near Charlottesville, Virginia, is one of several we received calling our attention to an unavoidable error in our November issue. The letter explains itself and supplies the correction.

> Editor, SCIENTIFIC AMERICAN:
>
> May I call your attention to an error that occurred in your November issue? On page 437 you have a picture under which is the caption: "World's Largest Searchlight in West Virginia." I should like to explain that Charlottesville, where the searchlight is located, is in Virginia, about 100 miles from the West Virginia line.
>
> I do not mean to be critical by writing this letter but simply wished for you to know the truth of the case.
>
> Frank S. Driver.

Appreciation

OF course we are prejudiced in the matter, but surely cannot be blamed for the pleasure we felt upon receipt of the following letter from Mr. S. Diamond, of Weber-Diamond and Company, Chicago, Illinois.

Our greatest efforts are conscientiously put forth toward the publishing of a magazine that is both informative and readable, one that either the scientist or the layman can read from cover to cover with steady interest—in short, one that will satisfy the need mentioned in this letter.

We thank Mr. Diamond for these kind remarks.

Editor, SCIENTIFIC AMERICAN:

It gives me much pleasure to read the SCIENTIFIC AMERICAN. But what surprises me is that a magazine with such a high standard of authenticity concerning scientific questions and such a fine uplifting influence, is not published twice a month.

Cultured Americans should be ashamed of themselves not to give much greater moral and financial support to this periodical, considering the vast number of other papers, journals and magazines which appear weekly and feed the public useless trash. The fact that the SCIENTIFIC AMERICAN is not eagerly sought by millions, whereas cheap magazines flourish, shows that there is a very large element in our community that refuses to do serious thinking. And yet high schools, colleges, and universities are yearly sending forth thousands of men and women graduates who are impressed with their own intelligence.

S. Diamond.

The Foucault Pendulum Experiment

MR. RUSSELL W. PORTER'S practical article describing the simple equipment and method necessary to perform the famous Foucault pendulum experiment, which makes visible the rotation of the earth, has brought us many interesting letters from readers. Below we reproduce five of those letters, the fifth one being of probable interest to those who still stubbornly insist that the earth is a rotating oblate spheroid instead of a stationary flat pancake, as any good Fundamentalist knows (?).

Editor, SCIENTIFIC AMERICAN:

Regarding the Foucault pendulum experiment, I may say that I have shown it, during a considerable number of years, to my classes and also to other audiences; and in these many demonstrations I have not had a failure.

The bob is a cast-iron sphere about six inches in diameter, accurately turned and nickel-plated. It is suspended by steel piano wire of diameter 0.02 inch and the length used is about 29 feet. The wire passes through a hole in the ceiling of a lecture room and then through a brass plate which is on the under side of a sort of low stool. The stool is firmly screwed to the floor above. No attempt is made to prevent the wire from twisting.

A steel pin projects below the sphere, care being taken to have it in the same line as the suspending wire. To exhibit the rotation, arcs of sand (radius 40 centimeters) are arranged on a level board on the lecture table—similar to Foucault's original arrangement. In addition, an arc lamp, placed in the plane of the swing, throws a shadow on a transparent scale. By adjusting this every few minutes the amount of rotation can be seen by a large audience.

Usually a slight ellipticity of path develops, the cause of which I have not tried to determine. It may be due to slight yielding of the support above, to air currents, or possibly to twisting of the wire. The amount of rotation is usually within about 4 percent of the calculated value, but I have not tried to measure it very accurately.

C. A. Chant.

Editor, SCIENTIFIC AMERICAN:

I performed the pendulum experi-

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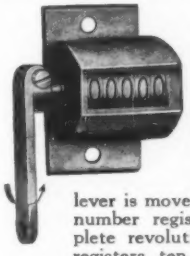

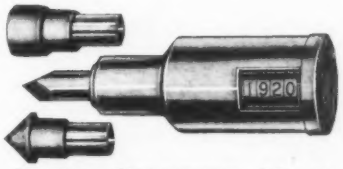

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ment described in the last SCIENTIFIC AMERICAN.

It is not necessary to use such a heavy weight unless great accuracy is required.

I used a steel ball 1¾ inches in diameter and the wire was only seven feet long.

In other respects my experiment was practically the same as described in your magazine.

U. G. Lee.

Editor, SCIENTIFIC AMERICAN:

My friend, James Crocker, and I are high school students and have had difficulty in obtaining information in respect to the pendulum experiment.

While looking through the July issue of the SCIENTIFIC AMERICAN we noticed the article by Mr. Porter and at once set to experimenting. We swung a 30-pound ball by a 15-foot wire, the results being very satisfactory in all respects.

We wish to express our appreciation for Mr. Porter's article and to thank the SCIENTIFIC AMERICAN for their wonderful work.

K. C. Shugart,
Los Angeles, California.

Editor, SCIENTIFIC AMERICAN:

Mr. Porter's article on the famous Foucault pendulum experiment interested me intensely, particularly his account of how to get "results" with short pendulums. During the years 1917-21 I performed a geat number of experiments with pendulums at Dawson, Yukon Territory, latitude 64 degrees, which town, in common with other sub-arctic towns, is particularly favorable for the experiment, owing to the fact that the rate of the rotation of the pendulum's plane increases as one approaches the poles of the earth.

On the east side of the Yukon River at Dawson is a large hollow wooden tower which supports the government ferry cable. This tower is about 150 feet in height and by using a 25-pound iron ball and a long piano wire I easily got the required deflections corresponding to about one rotation in 27 solar hours.

However, with short pendulums I had but indifferent success. I arranged them in different parts of the High School building where I was teaching science, but failed to get deflections as I was ignorant of the proper method of suspension so ably described in Mr. Porter's article.

This spring at the Markham High School where I am teaching mathematics and physics, I again repeated the experiment, suspending a cylinder of iron weighing over 100 pounds from the top of the steel water-tower. The upper attachment was exceedingly simple. I drilled a small hole through the steel platform 135 feet from the ground, drove a bicycle nipple through the hole, threaded the piano wire through the same, and tied it to a hard wood button at the top. The results were beautiful and were greatly appreciated by the keenly interested pupils. The giant pendulum swung through an arc of 30 feet and could be seen altering its plane at every stroke.

A very fascinating phase of this experiment has been the problem of working out a method whereby the pendulum could be kept swinging indefinitely and at the same time have no forces imposed on it which would prevent it from steadily changing its plane of vibration as it does when acted upon by the uniform force of

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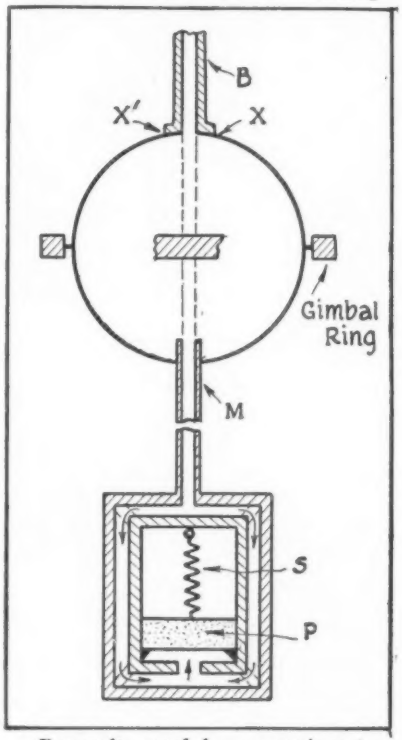
gravitation alone. It is particularly difficult to arrange these conditions where electrical agents are resorted to, on account of earth induction effects. I feel that I can speak with some authority on this subject as I have literally invented dozens of methods of doing the trick, and have actually constructed many models which were successful in keeping the pendulum in continuous motion, but invariably some slight force would make itself apparent in such a manner as to alter the ideal condition of a pendulum absolutely free to vibrate with equal ease in any plane. Mr. Porter's article has stimulated me to attempt the problem once again.

I have worked out the following



Foucault pendulum experiment suspension worked out by Mr. Gale and described in this column

solution to the problem of keeping a Foucault pendulum going. As will be noted in the accompanying diagram, the apparatus consists of three parts: At the top of the pendulum is a solid brass ball with a hole running through its vertical axis. The ball is accurately balanced and mounted by the well-known gimbal-ring suspension, thus being free to vibrate in any plane and at the same time have its point of suspension stationary. The second part is a long hollow tube of brass similar to a gasoline feed pipe which connects the lower opening in the ball with the pendulum bob at the bottom. The bob itself consists of two hollow cylinders one within the other. In the inner one is a brass piston P whose weight is partly neutralized by the spring S.

The action is as follows: The pendulum is started in a straight line by the method outlined by Mr. Porter. The pipe B is connected to a compressed air line and as the pendulum nears its lowest position the air rushing down the stem M follows the path indicated by the arrows and enters the bottom of the inner cylinder and raises the piston P. This raises the center of gravity of the whole pendulum and aids the kinetic energy it has developed in raising the bob as high on the other side as it was initially.

As the extremes of the amplitude of vibration are reached, the compressed air exhausts at X and X', respectively, to the atmosphere, allowing the piston to drop gently to its initial position. Since all of the parts are made of non-magnetic material the pendulum is not influenced by the earth's magnetic lines of force; and since the exhausting air reacts through the center of rotation and parallel to the axis of the pendulum the effect on its behavior is nil. The pipe B at its lower end is machined to the contour of the ball and is always in air-tight contact with the same, and since pressures on the ball are at right angles to its surface no disturbing turning moments are developed. I present the scheme for the criticism of your readers.

E. I. Gale,
Markham, Ontario.

Editor, SCIENTIFIC AMERICAN:

As you ask to hear from your readers regarding the pendulum experiment as described in your July issue, I avail myself of your invitation.

Of course every thinker knows that the experiment will prove none of the claims made for it.

A pendulum freely suspended will swing in *all manner of directions*, and the direction it may happen to take on any particular occasion cannot possibly show the direction in which pendulums have vibrated on all past occasions.

The idea that by this means the rotation of the earth may be manifested to the looker-on at the pendulum is, really, about the most childish conception that ever entered the mind of man, and its absurdity was demonstrated years ago.

We need something better than Foucault's pendulum experiment for proof of the earth's supposed motion. Instead of accepting the palpable fact that the freely suspended pendulum alters its plane of vibration in *every* possible way, it is "*assumed*" that the earth has rotated and carried the table, over which the pendulum is made to swing, around under the pendulum. Oh, Science; for shame!

It is "supposed" in the regular course of the Newtonian theory, that the earth is, in June, about 190 millions of miles away from its position in December. Now, since we can (in the middle north latitudes) see the north star, on looking out of a window that faces it—and out of the very same corner of the very same pane of glass, in the very same window—all the year 'round, it is proof enough for any man in his senses that we have no motion at all.

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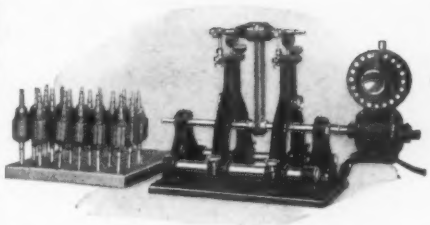

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Industries From Atoms

(*Continued from page 72*)

even crude petroleum and natural gas. These remarks will show you that there are well founded prospects for making coal the basic material of chemical industry. In particular the obtaining of liquid motor fuels, whether directly, by the high pressure hydrogenation of coal, or through water gas by catalysts, will surely play a very important part in those lands which have no deposits of oil."

These remarks of Dr. Tropsch are particularly interesting in view of the recent purchase of American rights to the hydrogenation process by one of our large petroleum companies.

Carrying further the idea of his own process of synthesis from water gas (a mixture of carbon monoxide and hydrogen), Dr. Tropsch stated that he had been able to obtain by its use every kind of compound present in crude petroleum from gaseous methane to solid paraffine waxes. Mixtures of gases similar to those he uses are found in nature, as are the catalysts necessary to promote the chemical reactions involved. From this he concludes that his method may very probably duplicate nature's way of forming petroleum in the earth. This is the only explanation of petroleum's formation which will allow one to conclude that it is still being formed.

New Resistant Glass

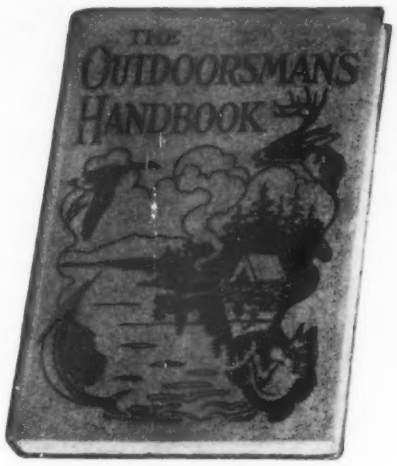
A GLASS that withstands pressure, heat, and acids better than any yet known is being successfully produced in Germany. It was first used for the manufacture of glass tube water gages and glass bars. The newest tubes produced by this method will sustain a cold-water pressure of 20, 45, 65, 80, and 100 atmospheres.

This glass is also used in weaving and silk-spinning mills to replace bobbins of wood, which frequently became splintered and rough and tore the threads of the material. The dye from colored threads could not be entirely removed from the wooden bobbins and impurities often resulted when colors were changed. Original attempts to substitute glass bars for the wooden bobbins were unsuccessful because the glass used would not withstand fluctuations of temperature. The new glass, however, will stand a sudden change from 160 degrees to 0 degrees, Centigrade, without damage.

A New Wood Pulping Process

A SEMI-CHEMICAL process for pulping wood for use in print papers and in the manufacture of pulp boards has been developed by the United States Forest Products Laboratory. In describing this new development, Rue, Wells, Rawlings and Staidl in a recent issue of *Chemical and Metallurgical Engineering* say in part:

"Sodium sulfite forms a natural nucleus for the group of chemicals selected by reason of its ready solubility, its neutrality, its reducing properties, and the solubility of such compounds as are formed by its reaction with wood. Sodium bicarbonate is used with the sodium sulfite to maintain approximate neutrality of the reaction during digestion. The organic acids are neutralized with the liberation of carbon



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"The wood chips are charged into a digester—preferably a globe rotary—and steamed for at least one half hour at atmospheric pressure, and the digester is then filled with liquor which is forced into the chips under a pressure of about 100 pounds per square inch. By a proper selection of the concentration of the liquor and the temperature of impregnation, the requisite quantity of each chemical will be absorbed by the chips. After the return of the excess impregnating liquor, the charge is brought quickly to a temperature between 140 degrees and 160 degrees Centigrade and held there for a period varying from one to six hours. The softened chips, which represent from 70 percent to 85 percent by weight of the wood, still have mechanical rigidity. The forces binding the fibers together have, however, been sufficiently weakened to permit the fibers to be rubbed or pounded apart without excessive injury. The separation of the fibers is advantageously accomplished by passing the softened chips through a rod mill. Sufficient water is fed with the chips to form a pulp suspension of between 4 and 8 percent. The pulp which leaves the rod mill is like a chemical pulp and can be washed, screened, and handled accordingly. The screenings are reground with subsequent charges of chips."

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Shirtless Sausages

NOT long ago considerable interest was aroused by announcements of sausages put up in rayon casings instead of the customary animal intestines. Now sausages without any casings are being satisfactorily made. Commenting on this editorially, *Industrial and Engineering Chemistry* says:

"Noticing an occasional lack of adherence between viscose casings and the sausage, especially after a few hours, the chemists called upon practical sausage men to discuss the problem. They were met not with suggestions of how to insure such adherence, but with the inquiry, 'Can you always make it behave that way?'

"Subsequently it was found that under certain conditions, after a period of twelve hours, the viscose casing could be easily stripped from the link sausage and, because of an invisible layer, probably of colloidal material, the sausage would maintain its shape even under severe handling and cooking conditions. This cannot be done with the natural casing, and the result is an increased demand for link sausage which, thanks to science, can now be had without the slightest trace of any kind of casing.

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See next issue for details.

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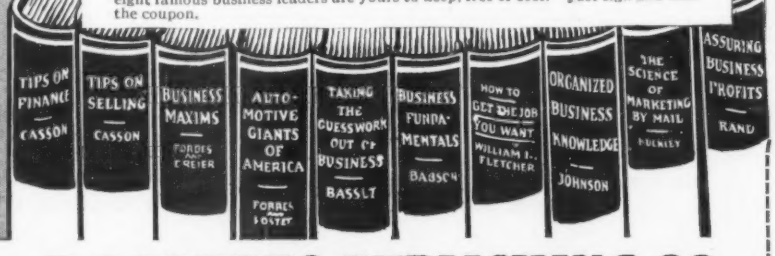
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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

CONDUCTED BY MILTON WRIGHT

Bringing Inventors and Manufacturers Together

THE job of bringing inventors and manufacturers together has now been in operation a year. It is a pleasure to report that a considerable number have been put in touch with each other to their mutual advantage.

In most cases where inventors have failed to dispose of their patents two general causes may be cited. First, there was no demand for the invention, or secondly, the inventor was unreasonable.

It has been our observation that many inventions have been conceived without any thought of the manufacturing possibilities. The inventor gets an idea, perfects it, and gets his patent. Then, for the first time, he begins to think of how he can make money out of it. As likely as not the invention is not suited to the needs of any manufacturer whom he can find, although it may be ingenious, economical and something the public could be educated to buy.

In other cases inventors expect too much money or insist upon unreasonable conditions. An inventor, we will say, finds a manufacturer through the SCIENTIFIC AMERICAN and the manufacturer makes him a definite offer, stating that he wishes to make the invented article of a certain material and sell at a certain price. The inventor thinks it ought to be made of some other material and sold at a higher price, and the negotiations fall through. Perhaps the inventor is better qualified to judge market conditions than the manufacturer, although this is not likely. Whether he is or not, however, the sale or lease of the patent fails because the inventor is unwilling to accept the terms offered him by the manufacturer.

Manufacturers, we find, often fail to obtain the inventions they are seeking because their wants are not specific enough. If they could tell the inventor just what to invent, their requirements would be met in a short time. This they cannot do, however, because they do not know exactly what they want. All that the manufacturer knows is the kind of article he is equipped to make, but he recognizes the ideal article when it is presented to him by the inventor. The following are some of the ways in which manufacturers are describing to us their needs:

"We are manufacturers of folding products and are always interested in any item along this line. At this writing we are particularly interested in some folding quality article that could be sold in conjunction with summer camping, both in the regular camping field and in the automobile field. Our products are being nationally advertised and any article put out under our trademark is given a wide distribution and has concentrated sales effort put behind it."

"We are in a position to manufacture all types and kinds of small metal stampings made from every kind of metal included with the lithographed metal from simple stampings to intricate machines. We should appreciate your supplying us as soon as possible with information regarding new patents of articles which we might manufacture."

"What we are particularly interested in is some device that can be sold by mail to the farmer direct or to the farmer agent, as our agency force extends from coast to coast and also includes some of the British possessions."

"I am in the market for a patent postage-stamp vending machine. If any of your inventors have such a patent for sale, I should be very glad to hear from you."

"We are at all times interested in any specialties in the brass or iron line. We manufacture brass goods for plumbing and various other uses and are interested in any specialties which would go to the plumbing or hardware trade. We shall be pleased to have you keep us in mind and when you get hold of any items which, in your opinion, have good commercial possibilities we will very much appreciate your sending us full details."

"We are anxious to have you list our company as much interested in your special services in calling attention of inventors to the interest we constantly have in new devices along the line of wet finishing machinery, turbine water wheels, wood or composition rolls. Our facilities include iron and brass foundry, machine shop, and structural steel plate department, as well as woodworking and roll-turning shops."

"We manufacture automobile bumpers and are looking for other articles to manufacture. We have a large plant equipped with medium and heavy presses suitable for hot or cold drawnwork, gas ovens for heat treating, tumbling barrels, polishing and grinding machines, complete plating outfits, et cetera. We are also equipped to make our own tools and dies. We also have a well-established sales force which we can press into service at short notice. We shall appreciate it very much if you will try to find something for us to manufacture in large volume."

"We should like to be on your list in case anything comes up in the line of rectifiers or vacuum tubes."

"We manufacture nursery furniture and are always seeking new patents to manufacture and sell."

"We are open for special inventions in hardware, leather goods and toys. We are factory distributors, although at this time we buy the different inventions, or take them on royalty, or have them manufactured in our own factory."

"We have been getting out an agricultural line; also ten-cent wood toys for the syndicate stores, and we are looking for additional items to add to our line, either wood or metal, preferably metal. We would be interested most in an item with a large field, that is, one universally used—something that would retail at not more than five or ten dollars. Items retailing for less than the above prices would be attractive."

Mere Substitution Is Not Invention

MERELY doing something a little differently from the manner in which it was done before is not enough to entitle one to a patent. This is made clear in the rejection by the Examiners-in-Chief of certain claims in the patent application made by Arthur D. Little and Carroll E. Carpenter for a newsprint paper of particular composition. In their argument the inventors declared:

"Since we are the first to have produced a workable furnish composed wholly of southern pine chemical pulp and gumwood mechanical pulp, and are the first to make merchantable newsprint paper of these ingredients, we claim protection generically for means and methods of making such workable furnish and for our products, commensurate with the novelty of our invention."

The Examiners-in-Chief, however, hold:

"We must remember that the patent law gives no domination merely to the first comer, nor any claim by right of occupation only. A patent is designed only to protect the inventor from those who would use his ideas and who really owe him something. The mere fact that he may be the first to embody an abstract principle does not give him the right to monopolize it unless the mere conception is new and requires his inventive originality which is not the case here."

They find that "the rejected claims cover an attempt to monopolize the manufacture of newsprint paper from southern pine, sulfate pulp and southern gumwood ground pulp. Merely substituting ground gumwood pulp for other ground wood, or merely reciting the proportions of sulfate pulp and ground wood pulp ordinarily used in making newsprint paper," they hold, "are not patentable."

American Inventions In Europe

THAT Europe holds more promise to many American inventors than America does is the startling conclusion reached by the American Manufacturers Export Association after a survey of European and American manufacturing methods. The day of cheap labor is past, it finds, and the market for labor-saving inventions has greatly improved. Furthermore, there was a large number of factories built during the war which were idle for a considerable time and their owners were ready to welcome American ideas. A considerable number of American inventions, as a matter of fact,

have been placed with European manufacturers since the war.

The statement is made that the enormous strides made in this country in the direction of quantity-production have sometimes worked to the disadvantage of the inventor. It is said there are a number of instances where American inventors, who were unable to promote their inventions in the United States, had gone to Europe and had met with success, later promoting the inventions successfully in the United States because of the European successes.

"It has been our experience that some inventors of extremely useful inventions, especially those relating to automobiles," says the Association's report, "have been unable to place their inventions on the market in this country, and have ultimately been forced to dispose of their inventions in England or France, where the automobile manufacturer is dealing only in small quantities and is able to make substantial changes in his design without an enormous capital investment.

"A striking example of this quantity-production lag in adopting inventions is illustrated by the four-wheel brake, adopted first by French automobile manufacturers before it was made standard in the United States. Another example of lack of initiative in the American automobile industry is found in the case of the well-known Knight engine, first exploited commercially in England. An even more striking example is found in the case of the so-called French type of desk telephone instrument, recently described in the New York daily papers. An importing house has been importing and selling these French telephones of an improved desk type, in New York City, and recently the local telephone company decided to manufacture similar telephones here and to install them at a slightly increased cost to those of their subscribers who desire them.

"The American inventor may well find, in many instances, that 'quantity-production' in his own country prevents the commercial adoption of his invention here, but if the invention can be demonstrated as a success in foreign countries, it will then be re-introduced in the course of time into the United States."

Don't Wait Too Long to Sue An Infringer

IF you delay too long in proceeding against an infringer of your patent, you may find that you have lost your right to assert your exclusive ownership against him. Such is the experience of the Dwight and Lloyd Sintering Company, Inc., which brought an infringement suit against John N. Greenwalt, in the Southern New York Federal District Court.

The patents in suit related to the "sintering" of fine ores, that is, their treatment with heat by which they are agglomerated into cohesive porous masses suitable for reduction in a blast furnace. Eliminating by simple but effective means the varying degrees of pressure throughout the mass and maintaining the ore particles in a state of quiescence, the process far surpassed the clumsy pot-roasting process previously employed. The first of four patents was obtained in 1908, the last in 1914.

Early in 1909, Greenwalt, a metallurgist of considerable experience, visited the sintering apparatus in a plant employed and installed by Dwight and Lloyd. Soon after, he installed a sintering apparatus for the Modern Smelting and Refining Company. From then until the present time he has been actively engaged in apparatus of this type for sintering fine ores.

"The fact that his licenses have paid him large royalties and have made very substantial investments upon the faith of his patents is persuasive of the fact that his claim of right to use his own device was not entirely devoid of merit," says Judge Thatcher. "With all of his operations the plaintiff has been quite familiar. His competition was by no means negligible and the plaintiff was thoroughly aware of it.

"Assuming infringement, I am entirely satisfied that Greenwalt honestly believed he was not infringing. This belief was confirmed and encouraged by the plaintiff's acquiescence, with full knowledge and without objection, in all that he did.

"Under the circumstances, I think it clear that the defense of laches must be sustained in so far as the first four patents in suit are concerned."

Repairs May Constitute Infringement

IF you repair a patented machine which you have bought, the repairs may constitute an infringement of the inventor's patent, for which you may be held liable. This is clearly illustrated in the case in the Delaware Federal District Court where Judge Morris held that Write, Incorporated, had infringed patent claims of the C and R Research Corporation.

The machine in question was one for coating carbon and other papers. Write, Incorporated, had rewound the equalizing bar, claiming it had exercised a well established legal right to repair. The C and R Corporation contended, however, that the act constituted a reconstruction of the bar and, therefore, an infringement. A new machine costs about 2800 dollars; the bar not more than six dollars.

In his opinion, Judge Morris gives a summary of the principles governing repairs of patented machines, which may be useful for purchasers of patented machinery to know. He says:

"Where a machine is patented as a whole, one who acquires, as by purchase, the right to use but not the right to construct it may so long as the identity of the machine is not destroyed, make repairs or replace the worn out parts, particularly the quickly wearing parts without which, notwithstanding the substantial character of the machine as a whole, it would be useless to the purchaser for more than a very limited time.

"This rule does not, however, authorize, under the pretext of repairs, a reconstruction or rebuilding of the machine. Substantial reconstruction is sufficient to make the act one of rebuilding instead of repair or replacement.

"Likewise the substitution of the vital and distinctively new part of the combination, if the whole invention resides substantially in such part, is a reconstruction of the machine.

"Again, the purchaser may not reconstruct a separately patented part or element of the machine without the consent of the owner of the patent for such part, for such reconstruction would constitute a making of the thing covered by the separate patent notwithstanding it might properly be considered a repair when viewed from the standpoint of the machine as a whole."

Dedicated to the Public

TWO birds are killed with one stone by the patent obtained by Dr. Max Phillips and M. J. Goss, chemists of the Color Laboratory, Bureau of Chemistry, Department of Agriculture. It is for a process for making an effective paint and varnish remover from para cymne, which comes from an oil obtained as a by-product in making paper pulp from wood. Not only is a waste product put to use, but the public receives free the benefit of the process.

The oil was until recently almost wholly an economic waste. It has been variously

Patents Recently Issued

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Pertaining to Apparel

SLIP—Adapted for use by women, a slash being provided in the back and lower portion of the garment, giving freedom to the legs in walking or sitting. Patent 1643884. A. Fox, c/o The Patricia Petticoat Co., 44 E. 32 St., New York, N. Y.

GARMENT FASTENER—In the form of co-acting fastening units which may be attached to portions of a garment for releasibly securing or hooking said portions together. Patent 1643883. I. C. Fife, 1808 North Park Ave., Chicago, Ill.

ARCH SUPPORTER—Which may be readily applied to footwear during manufacture or after, and will function to properly support the arch and tilt the foot. Patent 1643812. P. Iacovino. 199 Prince St., New York, N. Y.

CHILD'S OVERCOAT—Which may be conveniently lengthened without any sewing, and by simply ripping out a few tacks, unfolding the hem, and pressing the coat. Patent 1643159. S. Greenberg, c/o Louis Greenberg Bros., 520 8th Ave., New York, N. Y.

BUTTONHOLE SHIELD—For preventing the portions of a starched garment adjacent the buttonholes from being subjected to the stiffening action of starch in laundering. Patent 1643170. R. J. and P. J. O'Brien, c/o Rev. P. J. O'Brien, Bay Bulls, New Foundland, Canada.

RE-ENFORCED POCKET—To be applied at the opposite ends of the hand opening of a garment pocket to prevent tearing of the wall portions sidewise and endwise. Patent 1643162. H. Kirschenbaum, 366 Broadway, New York, N. Y.

BOW TIE—The wings of which may be formed in one piece, and the material for the knot wrapped to hold the parts in fastened position. Patent 1646295. A. Kimmel, 115 Broad St., Elizabeth, N. J.

estimated that from 750,000 to 2,000,000 gallons of this oil is annually produced in the sulphite pulp mills of the United States. The paint and varnish remover is prepared by mixing para cymne with grain alcohol, wood alcohol, and acetone, in equal parts by volume. This new paint and varnish remover has been dedicated by Messrs. Phillips and Goss to the people of the United States, thus making it possible for any one in the United States to make and use the new remover without the payment of any royalties to the inventors.

Department chemists in recent years also have worked out processes for utilizing such wastes as straw, rice hulls, peanut hulls, and corncobs, as well as for the more profitable utilization of various cull fruits and vegetables. Several commercial concerns are now making salable commodities from large quantities of cull oranges and lemons by these new processes.

What Price Infringement?

IN an action for infringement of a patent, the measure of damages is the plaintiff's loss, not the defendant's gain. The mere fact, therefore, that the infringer has not profited by his infringement will not always prevent the injured owner of the patent from recovering damages.

Under such circumstances it would be natural to fix damages according to a reasonable royalty percentage. Such was the effort recently made by the Automatic Pencil Sharpener Company suing the Boston Specialty Corporation in the Federal District Court of Southern New York for infringement of patents on pencil sharpeners. The defendant showed a loss of about 6000 dollars for the entire period of infringement.

"To justify this recovery upon basis, the proofs," Judge Thatcher holds, "must at least indicate some rational method by which the amount of the royalty may be fairly, if not exactly, determined—the inquiry in each case being: what would a reasonable man, who wished to go into the business in the hope of procuring a reasonable profit, be willing to pay for a license under the patent in question?

"Since the determination of a reasonable royalty basis necessarily involves the allowance to the defendant of at least a fair chance to realize a reasonable profit, there can be no recovery of damage upon that basis if the proofs disclose, as they do in this case, that the payment of any royalty at all would have been quite unreasonable, or in the nature of a gratuity."

Ireland's New Patent Law

THE new patent law of the Irish Free State became effective last October 1. It closely resembles the British Patent Act. Under its provisions, it is compulsory to file with each application a statement concerning the relation of the Free State application to a corresponding application, if any, filed or granted in the United Kingdom. Where no application on the same invention has been made in the United Kingdom, the applicant must submit a declaration made by a patent agent duly registered in the Free State or in London that a search for novelty has been made, either in the National Library of Ireland or in the Patent Office in London, and that no anticipation of the invention has been found. Where a British application has been refused, the applicant must lodge a declaration to the effect that the rejection was not based on the grounds of anticipation.

The Irish Free State has become a member of the International Union for the Protection of Industrial Property. Applicants who have filed applications in the convention countries since the establishment of the Free State, that is since December 6, 1921, and prior to the commencement of the new act, may within one year apply in Ireland under the International Convention.

A new Trademarks Act, which also follows the British Trademarks Acts, went into effect at the same time. Free State registration of trademarks already registered in the United Kingdom may be effected before April 1, 1928, to obtain the priority of the British registration.

The Copyright Act, for artistic and literary works, following closely the Copyright Act of the United Kingdom, went into effect on August 1.

Pertaining to Aeronautics

RIGID AIRSHIP—Provided with means for scooping up water while the ship is in motion, thereby causing it to settle down, and serving to moor it in a lake or stream. Patent 1642727. O. Geisler, 6947 So. Peoria St., Chicago, Ill.

Chemical Processes

PROCESS OF DESUGARING MOLASSES—Which includes the direct treatment of the molasses with tribasic Barium silicate derived from Barium sulphite and silica, to release the sucrose. Patent 1646323. G. L. Spencer, attention W. G. Vreeland, c/o Cuban American Sugar Co., 136 Front St., New York, N. Y.

Designs

DESIGN FOR A TUMBLER OR SIMILAR ARTICLE OF GLASS—Patent 73436. G. Dougherty, c/o Economy Glass Co., Morganstown, W. Va.

DESIGN FOR A RADIATOR ORNAMENT.—The inventor has been granted two patents for ornamental designs of this nature. Patents 73455 and 73456. I. Von Haxthausen, c/o G. D. Ames, 578 Madison Ave., New York, N. Y.

DESIGN FOR A TIRE-PRESSURE GAUGE—Patent 73505. G. S. Loy, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

DESIGN FOR A TUMBLER OR SIMILAR ARTICLE OF GLASSWARE—Patent 73511. E. C. Schrader, c/o Economy Glass Co., Morganstown, W. Va.

DESIGN FOR A TEXTILE FABRIC—Patent 73544. E. A. Weeks, c/o Weeks Sawyer & Co., 87 Leonard St., New York, N. Y.

DESIGN FOR A COSTUMER—Patent 73576. W. P. Neal, 1335 E. Breckenridge St., Louisville, Ky.

DESIGN FOR A HAND-BAG FRAME—The inventor has been granted two patents for ornamental designs. 73564 and 73565. W. T. Goldsmith, 391 Mulbury St., Newark, N. J.

Electrical Devices

CONNECTOR FOR TELEPHONE RECEIVERS AND THE LIKE—A flexible device in the shape of sockets for readily holding the metallic tips of phones so that the receivers are connected in series. Patent 1643269. L. Foote, Pedro Miguel, Canal Zone.

TRAFFIC SIGNAL—The casing of which is cushioned, so that the electrical connections, and other parts will not be broken when struck by a passing vehicle. Patent 1643925. H. Cooke, Jr., 22 Hepworth Place, Garfield N. J.

MULTIPLE FUSE PLUG—Having a plurality of fuses which can be successively introduced into the electrical circuit as preceding ones burn out, without replacement by a new plug. Patent 1644969. F. W. Williams, 339 No. Belmont St., Los Angeles, Calif.

SPARK PLUG—Of the self-cleaning type, whereby any accumulation of carbon or oil will be automatically removed from the surface of the core insulator after each explosion. Patent 1646318. E. A. Schneider and M. Hertz, c/o Morris Hertz, 581 5th Ave., New York, N. Y.

Of Interest to Farmers

AGRICULTURAL MACHINERY—Designed for use as a cultivator, also for plowing the ground, planting the seed and leveling the ground after the seed has been distributed. Patent 1644596. F. A. Krieger, 110 No. 2nd St., Livingston, Mont.

CHICKEN ROOST—Formed of removable sections, so that any number of the sections may be employed, and may be readily removed for cleaning. Patent 1646334. A. C. Wollenhaupt, Box 34, San Antonio, Texas.

Hudson Tires and Cars

HUDSON tires and Hudson cars were in conflict recently over the use of the trademark "Hudson." While the tire manufacturer had used the word first, the court held that the particular manner in which he later used the mark converted the originally proper use into a violation of plaintiff's rights.

The tire company grew from a stable near the Hudson Boulevard in Jersey City. Converting it into a garage in 1906, the proprietor named the place the Hudson Garage. About five years later he drifted into the making of tires, first at Jersey City and after 1914 at Newark. In 1915 the name was changed to the Hudson Tire Company, Inc. In 1919 the name "Super" was adopted as part of its trademark and an inverted triangle was used.

In 1909 the Hudson Motor Car Company was incorporated and began using the word Hudson with the inverted triangle as its trademark. In 1916 the motor company secured registration of its "Super-Six" trademark.

In allowing an injunction against the tire company, Judge Runyon of the New Jersey Federal District Court says:

"While the evidence shows that the Hudson Motor Company does not manufacture its own tires but uses standard makes for the purpose of equipping its cars, tires are so closely allied to automobiles in the public mind, and indeed so essential a part of the completed car, that a phrasing or trademark used to exploit a tire which is identical with or largely similar to the phrasing or trademark by which a certain make of automobile is known, is distinctly calculated to convey the idea of common origin in the public mind."

Brazil Establishes a New Trademark Bureau

AN International Trade Mark Bureau has recently been established at Rio de Janeiro, under the Treaty of the American Republics signed at the Santiago Conference of 1923, for the purpose of registering trademarks of the so-called southern group of American republics. Reciprocal protection will be given the marks of the southern and northern groups through interchange between the new bureau and the Havana bureau which now performs the same service for the northern republics.

Of General Interest

COMBINATION DISH MOP AND SCRAPER—Comprising a bunch of mop strands secured around a handle, and scraping material surrounding the upper portion of the mop strands. Patent 1643857. A. Sacks, c/o The Novelty Cord and Tassel Co., 57 Hope St., Brooklyn, N. Y.

COMBINATION DISH DRAINER AND TUB COVER—Which will take the place of wash tub covers as commonly employed, and in addition will provide a drainer for dishes, silver and other articles. Patent 1643905. M. H. Rossner, 3050 Bainbridge Ave., Bronx, N. Y.

REAPEATING DEVICE FOR PHONOGRAPHIC RECORDS—Readily adapted to different sizes and kinds of records, and which will not stick when the needle is passed over it. Patent 1643369. S. M. Bookman, 927 Westchester Ave., Bronx, N. Y.

TUNNEL-VENTILATING SYSTEM—Including air ducts on the roof and below the bottom, whereby a forced circulation of air is provided, and the foul air discharged to the atmosphere. Patent 1643868. J. M. Woll, c/o F. V. Woll, 13 Sampson St., Pittsburgh, Pa.

STORAGE TANK—For liquids of different specific gravities, in which provision is made for the expansion and contraction of the tank contents while hermetically sealed. Patent 1643924. E. M. Clark, Clarkson, Mich.

FITTING FOR GAS-PRESSURE GAUGES—Employing two gauge glasses parallel with each other and connected by a flexible U-shaped fitting between the gauges and the gas pipe for ascertaining pressure. Patent 1643886. P. Goodman, 523 Atlantic Ave., Brooklyn, N. Y.

COMBINATION DRAIN BOARD AND TUB COVER—Stamped from a single piece of steel, combining lightness with strength, removably supported by hangers over the tub and below the edge level. Patent 1643906. J. W. Russel, c/o Marietta Hollow Ware & Enameling Co., Box 43, Marietta, Pa.

FIRE EXTINGUISHER—For sprinkling extinguishing fluid, the arrangement being such that the fluid will be sprayed in small jets, means are provided for quick refilling. Patent 1642608 E. Halikman. The Safanshire Chemical Co., 125 W. 67th St., New York, N. Y.

TOBACCO-PIPE CLEANER—Apparatus for cleaning the bowl and stem of a tobacco pipe by circulating a current of heated air therethrough. Patent 639,500. J. W. Pitts, 5725 Woodward Ave., Detroit, Mich.

BOX—Which may be made of any suitable material such as cardboard, cut from a single blank, and held together without use of nails or adhesives. Patent 1639793. A. H. Beyer, 1943 E. 82nd St., Cleveland, Ohio.

BROILER—In which a novel circular heat-reflecting plate serves the additional function of draining the juices from the meat being broiled into a covered receptacle. Patent 1642071. R. T. Hosking, 818 Park Ave., Wilmette, Ill.

NAIL BUFFER—Providing in addition to the buffer element a reservoir or magazine section, adapted to contain a supply of nail polishing powder. Patent 1643164. H. MacDougall, 85 Oakland Road, Maplewood, N. J.

SHIP'S RIGGING—Including a leg-of-mutton mainsail, starboard and port topsails, and triangular depending starboard and port yard sails, for providing more driving efficiency when going to windward. Patent 1642716. A. Bentzen, c/o Annapolis Dairy Products Co., Annapolis, Md.

WINDOW SEAT—Which may be detachably connected with the sill of a window frame, adjusted to a desired position and securely held against movement, for window cleaning operations. Patent 1642792. E. Sonntag, 664 8th Ave., Astoria, L. I., N. Y.

PORTABLE THEFTPROOF BOX—A receptacle for use by messengers carrying cash, or valuables, the box is locked to the messenger's body, and cannot be detached without the proper key. Patent 1643189. N. Urovsky, 1304 Grand Concourse, New York, N. Y.

AUTOMATIC SHUT-OFF DEVICE FOR LAWN SPRINKLERS—Which may be adjusted to shut off the water supply to a sprinkler when a predetermined amount of water has been sprinkled. Patent 1642821. J. M. Noble, Gustine, Calif.

WINDOW CLEANER—Having a pair of cleaning heads attached to handle members, and adapted to be positioned for cleaning simultaneously opposite sides of a window pane. Patent 1644642. K. Horihta, c/o N. Watanabe, 573 Amsterdam Ave., New York, N. Y.

FIRE-PREVENTING APPARATUS—Adapted to be combined with the ridge of building for supplying a fire repellent liquid to the roof to check or extinguish a fire. Patent 1644603. J. P. O'Neill, 9125-245 St., Queens Village, L. I., N. Y.

METHOD OF UNDERPINNING—When excavating adjacent a building, for preventing sand or clay from running out from under foundations and causing a settling of the interior footing. Patent 1644572. J. V. Ferry and A. P. Miller, c/o J. V. Ferry Co., Mediterranean and Virginia Aves., Atlantic City, N. J.

MATTRESS—In which the fibers are placed in a substantially perpendicular manner to the cover, giving greater resiliency, a better circulation of air, and requiring less felt. Patent 1644600. J. I. Morgan, c/o Farmville Oil & Fertilizer Co., Farmville, N. C.

COMBINATION HAIR COMB AND BRUSH—Which is easily held, and by which one may comb and brush the hair at the same time, the device may be readily cleaned. Patent 1644208. H. Stephens, Jr., 296 Matheson Ave., Winnipeg, Manitoba, Canada.

CAN OR RECEPTACLE—Having novel means for securing the cover to the body, effecting a hermetic seal, yet permitting the quick removal of the lid without the use of tools. Patent 1643009. F. H. Gouffer, 47 So. East St., Carlisle, Pa.

MEASURING DEVICE—A combination of tape measure and extensible rule structure, in which the rule structure is used as a support for the tape in linear form. Patent 1642977. J. Stork, 3780 Swift Ave., San Diego, Calif.

WINDOW-SASH-RETAINING DEVICE—For holding the sash in any desired position without the use of the ordinary sash weights and appurtenances, readily detached for repair or replacement. Patent 1644036. F. Rooney, 10 North 12th St., Flushing, L. I., N. Y.

PORCH SWING—Which affords facilities for making use of motion which results from the operation of the swing to oscillate a fan above the seat. Patent 1640274. G. L. Hall, 2011 So. 44th St., St. Petersburg, Fla.

STORE FURNITURE—A display case supported in a plane above the counter top yet within clear view of patrons, and out of the way of those receiving goods. Patent 1645470. H. A. Alheit, 304 Main St., Cambridge, Mass.

DETACHABLE FASTENING FOR HANDLES—Which may be easily manipulated to rigidly and securely connect the handle to a broom or mop head, while permitting ready disassociation of the part. Patent 1645490. C. M. Keener, c/o Zachry Mfg. Co., Atlanta, Ga.

CABINET FOR TYPE—Having compartments for the reception of type or articles of different sizes, to be placed in one end and pass by gravity to the opposite end. Patent 1645445. P. C. Mose, Johnson City, Tenn.

HAT HOLDER—Capable of application to the side door, or back of front seat of an automobile, or the back of a theater chair, or other available support. Patent 1645478. J. H. Gibson, 800 Clifton Ave., Clifton, N. J.

MATCH BOX—Which contains a supply of ordinary unused or live matches, and is adapted to receive burnt matches when no other receptacle is available. Patent 1646300. C. B. Martin, 1129 6th St., N. W., Canton, O.

LIQUID DISPENSER AND APPLICATOR—Particularly adapted for hair oils, shoe polishes and similar classes of material to be applied in small quantities, and then rubbed in. Patent 1646324. R. Stewart, 10914 108th St., Ozone Park, L. I., N. Y.

Hardware and Tools

SOCKET WRENCH—Having a removable handle bar and a socket head mounted on a shank by a universal connection so that it may be operated at various angles or may be locked rigidly as a straight wrench. The inventor has been granted two patents, 1643814 and 1643855. J. N. Peterson, c/o Peterson & Carlborg, Milwaukie, Oregon.

KEY PROTECTOR—Formed from a single piece of spring metal, which may be associated with the keyhole plate of a door to prevent a key from falling out. Patent 1643904. U. L. Rife, Sound Beach, Conn.

SOCKET WRENCH—In which any one of a plurality of sockets may be adjustably screwed on the shank, adapted for use on speed, offset or T wrenches. Patent 1643901. J. N. Peterson, c/o Peterson & Carlborg, Milwaukie, Oregon.

DOOR LATCH—Which is automatically acting when the closure is swung to, which will be rugged, and which may be conveniently locked against operation. Patent 1642612. C. Haarberg, Petersburg, Alaska.

REFLANGING TOOL—By means of which the turning of a member clockwise is effective to make a flange on the end of a pipe, held in a vise. Patent 1639173. A. Fountain, F. Balzarini, and T. Thiel, 314 Eleventh St., San Francisco, Calif.

HOSE-CLAMP APPLIER—A tool which is simple and can be easily manipulated to secure a clamp in place on a hose or like object. Patent 1643160. F. W. Gunn, 318 Columbus Ave., Boston, Mass.

HINGE—Comprising two knuckle members, a spherical bearing member and means for resiliently securing the bearing member to the knuckles, and the knuckles together. Patent 1644638. A. J. and J. A. DeBry, c/o La Directeur de L'Office Picard, Paris, France.

COMBINATION CLAMP—Designed to embody means for clamping an iron rod, and including a stirrup for engagement by connections for actuating the rod as used in well pumping. Patent 1645463. E. R. Thomas, Denaya, Okla.

Machines and Mechanical Devices

ADJUSTABLE GUIDE FOR WINDING MACHINES—Providing thread or yarn guides for each spool, with a screw member for causing a back and forth adjustment, without interfering with the longitudinal adjustment. Patent 1643914. G. F. Albach, Jr., attention of Mr. New, c/o Schwazenbach-Huber Co., Union City, N. J.

VULCANIZING MOLDING APPARATUS FOR RUBBER TIRES—For repairing pneumatic tires, a shape-retaining member holding that portion of the tire, which is not to be repaired, out of contact with the heat. Patent 1643869. P. Barre, c/o Office Pickard, 97 Rue St. Lazare, Paris, France.

FARE-REGISTERING DEVICE—A recording mechanism, by means of which the total number of fares paid on rides in amusement parks, is registered and temporarily displayed. Patent 1643907. G. E. Schacht, Madison Ave., Fanwood, N. J.

BIAS-CUTTING MACHINE—For cutting strips from fabrics or textile materials, whereby the cutting and feeding mechanism may be adjusted to produce angles other than 45°. Patent 1643157. P. Gardner, c/o H. M. Bunker & Co., 56 Worth St., New York, N. Y.

FRUIT SIZER—For the purpose of assorting or grading peaches, pears or other tender fruit according to size, and handle the fruit without

bruising the skin. Patent 1643190. J. B. Von Canon, West End, N. C.

PLATE CYLINDER FOR ROTARY INTAGLIO PRINTING—Comprising a hollow shaft with a perforated partition at its center, water entering into the shaft and passing through, acting in its passage as a cooling medium. Patent 1643145. C. Winkler, c/o Winkler, Fallert & Co., Bern, Switzerland.

AERIAL TRAMWAY—For handling and conveying loose bulky material from a fixed loading point to a desired discharge point, releasing means being controlled by a latch. Patent 1643214. G. M. Kilcarr, c/o Interstate Equipment Co., 25 Church St., New York, N. Y.

INK FOUNTAIN FOR PRINTING PRESSES—For distributing ink to the ink drums in the quantity desired and irrespective of the direction of the rotation of the drums or cylinders. Patent 1642809. W. H. Granger, c/o Duplex Printing Press Co., 323 De Young Bldg., San Francisco, Calif.

PLUCKING MACHINE—Which is manually controlled, and which will rapidly remove the feathers from a fowl, or other poultry, without tearing or bruising the skin. Patent 1644621. E. Warner, 324 Union St., Union City, N. J.

TICKET SELLER—By the simultaneous action of which tickets are unwound and cut off a coin draw opened for change making and the quantity of tickets sold recorded. Patent 1644639. F. G. Diago, Aptdo. 1972, Habana, Cuba.

COTTON GIN—Having means whereby air is employed to remove mote and dirt from cotton during its passage, and without removing the cotton from the saw blades. Patent 1642982. R. L. Willis, Box 121, Arvin, Calif.

STENCIL DUPLICATING DEVICE—A rotatably mounted cylinder by which a large number of copies of the matter embodied in its stencil sheet can be made with a single inking. Patent 1643028. E. E. Morlan, 3916¼ Wisconsin St., Los Angeles, Calif.

APPARATUS FOR PUMPING OIL WELLS—Whereby the pump rods are dispensed with, and the oil is pumped out of one pipe by liquid pressure applied through another pipe to pumping equipment. Patent 1643616. A. O. Zinn and J. A. Bried, 1025 Stock Exchange Bldg., Los Angeles, Calif.

HOSIERY MACHINE OF THE STRAIGHT OR FLAT WEB TYPE—An apparatus for mounting upon the carriage of a flat web hosiery machine for producing in the knitted fabric vertical stripes and varied designs. Patent 1645439. L. Marneux, nee David, c/o C. Bletry, 2 Blvd. de Strasbourg, Paris, France.

LIQUID MEASURING AND DISPENSING APPARATUS—Which will retain milk or other liquid in a cool and sanitary condition, particularly adapted for dispensing small quantities of milk in retail stores. Patent 1645475. D. Cohen, 1725 Bath Ave., Brooklyn, N. Y.

DEVICE FOR ELIMINATING THE PRINTING OF IMPRESSIONS ON IMPRESSION-CYLINDER PACKING—An attachment, operable by the automatic throw-off mechanism, for cylinder printing presses of the McKee four-color type. Patent 1645469. F. J. Albert, 400 26th St., Guttenberg, N. J.

OPERATING MECHANISM FOR ICE-CREAM FREEZERS—Having means for continuously rotating the dasher of the freezer, permitting the operator to actuate the mechanism by an up and down rocking movement. Patent 1645458. F. G. Scott, Box 225, Central Park Sta., Houston, Texas.

DEVICE FOR RECOVERING CASING FROM WELLS—For recovering parted string from well casing, and positively and rigidly connecting the sections so that they may be raised as a unit. Patent 1645010. M. M. Kinley, 810 E. 8th St., Tulsa, Okla.

CONDENSING APPARATUS—Having a plurality of vertically disposed tubes upon which is sprayed water so that a thin film will travel over the surface for rapidly cooling hot gases within. Patent 1645481. F. G. Grell, 105 Villita St., San Antonio, Texas.

Medical and Surgical Devices

SPLINT—Particularly for use in fractures of the elbow, lower arm and upper forearm, also for elevating the shoulder in case of fracture of the clavice. Patent 1643850. A. W. Jones, c/o Johns & Flanagan, Attys, Randolph, Wis.

DENTAL AMALGAMATOR—A device which can be operated mechanically or manually, for thoroughly and quickly mixing silver and quicksilver, for use in filling teeth. Patent 1643847. O. F. Hallum, and A. Sletten, c/o Dr. O. F. Hallum, Hayfield, Minn.

SOLUBLE STRIPS FOR LOCAL MEDICATION OF THE ORAL CAVITY—The slowly soluble material being adapted to be retained between the cheek or lips and the gums, and insure a prolonged and uniform treatment. Patent 1642653. A. D. Goldstein, 168 W. 86th St., New York, N. Y.

DEVICE FOR MASSAGING AND LUBRICATING THE HUMAN SYSTEM—Which comprises a reservoir and a curved tubular massage element, for lubricating the rectum and prostate gland keeping them elastic and avoiding the effects of constipation. Patent 1644606. S. E. Pelphrey, French, New Mexico.

Musical Devices

KEYBOARD INDICATING DEVICE AND METHOD OF REGISTERING PERFORMANCE—Which functions with the manual keyboard of a piano, or dumb-piano, for the purpose of furnishing the student with a visible indication of his efforts. Patent 1644960. J. Stauss, 3622 Chestnut St., New Orleans, La.

Prime Movers and Their Accessories

TWO-CYCLE ENGINE—Which promotes a thorough scavengering after each explosion, and supplies a uniform combustible mixture to the explosion chamber, after it has been scavengered. Patent 1642655. E. J. Hart, 2301 "S" St., Vancouver, Wash.

ROTARY STEAM ENGINE—Having a minimum number of working parts, permitting its direct connection to a driven shaft, eliminating connecting rods and a crank shaft. Patent 1642996. H. C. Johnson, 409 No. 4th St., Colton, Calif.

CARBURETOR—Having auxiliary carbureting means, so that in addition to the heating of the fuel, part of the same may be mixed with air in an unheated condition. Patent 1644233. S. J. Brindley, 4420 No. Artesian Ave., Chicago, Ill.

Railways and Their Accessories

RAIL JOINT—Which affords facilities for connecting the end portions of two aligned rails without the use of the usual fish plates and connecting bolts. Patent 1643830. W. H. Bowles, c/o R. G. Nunley, Meadow Creek, W. Va.

CROSSTIE—Particularly adapted for railroads in mines, holding the ends of the rails together without slipping or spreading, and permitting ready adjustment of the gage. Patent 1643923. G. C. Christner, R. F. D. No. 2, Box 17, Riversville, W. Va.

Pertaining to Recreation

GOLF BAG—Which functions to completely enclose and lock the clubs for shipment or storage, and facilitates the selection and removal of the clubs when in use. Patent 1644592. W. L. Howland, 1608 So. Penn Ave., Mason City, Iowa.

Pertaining to Vehicles

WINDSHIELD WIPER—Adapted to be moved periodically across the entire width of the windshield of a vehicle in a horizontal manner and return along the same path. Patent 1643919. J. Bornstein, c/o J. N. Cohen, 150 Broadway, New York, N. Y.

MULTIPLE SWITCH—For controlling a plurality of vehicle direction signals, such as electric lamps, and by which the operator may know exactly what signal is being rendered active. Patent 1643894. R. Law and E. J. Sweda, 39-48, 55th St., Woodside, N. Y.

DEMOUNTABLE RIM—Which will be safe against accidental loosening, and absolutely concentric to the wheel axis without the adjustment of a number of separate rim bolts. Patent 1639991. F. W. French, 3027 Logan St., Fruitville, Calif.

REEL ATTACHMENT FOR AUTOMOBILE WHEELS—Which may be applied to a rear wheel when jacked up for holding a measurable quantity of wire, and readily knocked down to disengage the wire. Patent 1642630. F. V. Sjolander, Jamestown, Kansas.

ADJUSTABLE STEERING KNUCKLE—For automobiles, affording facilities for mounting the spindle to turn anti-frictionally and so that the spindle bearings will be kept well lubricated. Patent 1642640. E. Bouch and T. R. Shriver, R. R. No. 1, Worthington, Pa.

TOY WAGON—Wherein the wagon body remains stationary, or may be caused to revolve from the ground wheels when the wagon is drawn along. Patent 1642591. C. E. Morris, 1230 No. 29th St., Philadelphia, Pa.

END-GATE LOCKING DEVICE—For wagon or truck bodies, which will hold the gate rod securely, but may be released by manipulating one end thereby facilitating withdrawal or replacement. Patent 1642059. J. S. Bower, Aledo, Ill.

DISC WHEEL—Having a demountable rim which may be readily removed from the wheel by the rotation of a crank. Patent 1643172. R. H. Pierce and G. A. Anderson, c/o R. H. Pierce, 645 Olive St., Eugene, Oregon.

TREE REMOVER—Comprising a front truck, a rear truck and a lever-like frame structure for removing, transporting and transplanting a tree and its roots and soil clinging thereto. Patent 1643141. A. W. Wadley, Central Ave., Yonkers, N. Y.

TRAILER—Readily connected to a motor vehicle, relatively light in weight, adapted for accommodating horses or cattle, and for confining the animal against escape during transit. Patent 1642823. A. Ordway, Box 262, Newman, Calif.

DIRECTION SIGNAL—A manually operated signal, capable of being applied to a window glass, and operated from a point interiorly of a closed vehicle. Patent 1642995. L. E. H. Huber, 360 East Palm Lane, Phœnix, Ariz.

NON-PNEUMATIC-TIRE FILLER—Including an annular coil spring element, a contractible and expansible member encircling the same, to take the place of the inner tube and eliminate its disadvantages. Patent 1644609. J. P. Prall, Woodbridge, N. J.

SNUBBER—Which is readily applicable to vehicles, and constantly operable to effectively snub excessive rebound and prevent breaking of the springs, and vibration of the body. Patent 1643927. J. Dixon, 939 East Van Buren St., Phœnix, Arizona.

TAXI ADVERTISING DEVICE—Especially adapted to be positioned within a taxicab, bus, or other public automobile conveyance which is operated through the medium of the engine. Patent 1645804. E. Dobrowsky, 168 W. 95th St., New York, N. Y.

HOME GASOLINE STATION—Which does away with hand pumping, and makes use of the weight of the car, or the operator, for forcing gasoline from the reservoir to the car tank. Patent 1645594. E. E. Hassler, Chapman, Kans.

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INDEX TO ADVERTISERS

SCIENTIFIC AMERICAN—JANUARY, 1928

American Farm Machine Co.	86	Laboratory Materials Company	76
American Lead Pencil Co.	86	Lambert Pharmacal Company	73
American Pipe Bending Machine Co.	79	Liggett & Meyers Tobacco Company	Color Insert
American Telephone & Telegraph Co.	76	Los Angeles Chamber of Commerce	6
Atlas Indicator Works	86		
		Metal Cast Products Company	86
Francis Bannerman Sons	76	Metallic Sign Letter Company	86
Bernard & Heller	86	William Mogey & Sons, Inc.	86
Broderick & Bascom Rope Co.	75	Munn & Company	81-86
Box 177	82		
Box 178	82	Norton Company	Fourth Cover
		Numismatic Company	86
Chicago Stock Gear Works	86		
Chicago Technical College	79	Packard Motor Car Company	Third Cover
Cortez Cigar Co.	86	Popular Chemistry Company	86
		Portland Manufacturing Company	74
Dayton Steel Foundry Company	77		
F. J. Drake & Co.	79	Riverbank Laboratories	82
Drawer 632	82		
Peter J. Dukelow	86	William A. Schaerr	86
		Schwerdtle Stamp Company	79
G. Elias & Bro., Inc.	76	James Sinclair	86
		S K F Industries, Inc.	Second Cover
Field & Stream	85	Stephenson Laboratory	86
Firestone Tire & Rubber Company	79		
Forbes Magazine	87	Timken Roller Bearing Company	4
B. B. Fortney	86		
		Unisol Manufacturing Company	86
General Electric Company	2	Up-To-Date-Machine Works, Inc.	69
Golden Book Magazine	84		
		Veeder Manufacturing Company	81
Alexander Hamilton Institute	76		
Harper & Bros.	96	Westinghouse Electric & Mfg. Company	71
Hoffman Specialty Co.	78	Winchester Mfg. Company	86
		Wisconsin Electric Company	83
International Correspondence Schools	77		
International Harvester Company	1	Henry Zuhr	86

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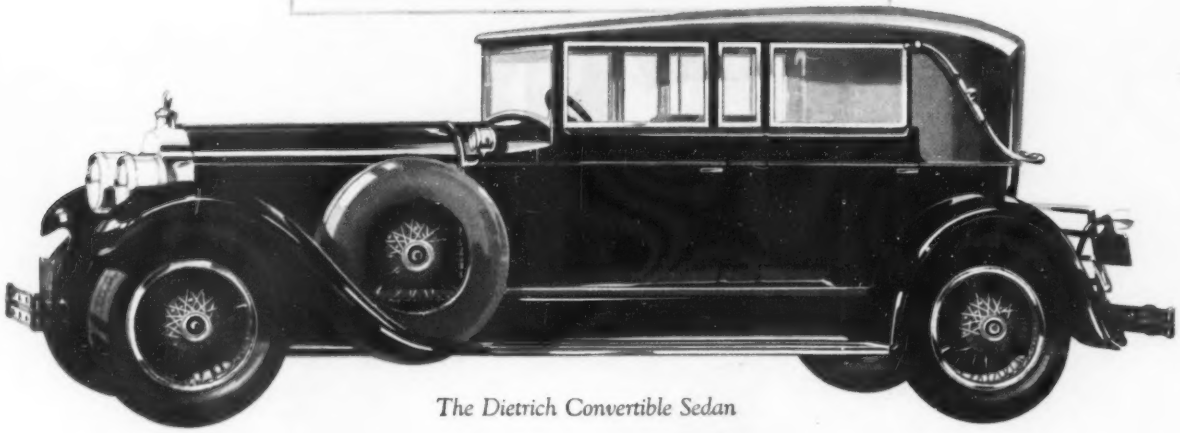


The Dietrich Convertible Sedan

CULTURED women instinctively recognize and appreciate fine work—whether it be the decorator's, the modiste's or the motor car designer's.

The preference such women have shown for Packard cars—not in a few large centers only but in every section of the Union—is a tribute to three particularly well recognized Packard qualities, beauty, prestige and long life.

For women wish the family car and particularly their own private cars to reflect good taste and discrimination inside and out, to possess a distinguished reputation and, withal, to be of good quality and lasting service.

Woman recognizes a Packard—either Six or Eight—to be something more than a mere utility. She sees it also as a work of art. Here is necessary transportation made luxurious—and clothed with beauty.

The very needlework, and there is much of it hidden in the soft upholstery of a Packard interior, reflects the pride which Packard women take in aiding to produce the best built car in the world.

PACKARD

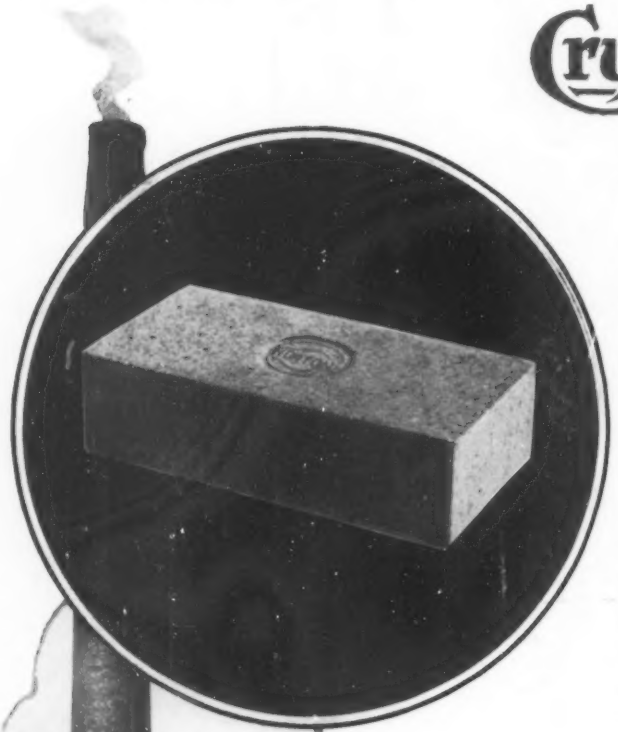
ASK THE MAN WHO OWNS ONE

PRINTED IN U. S. A., BY ART COLOR PRINTING COMPANY, DUNELLEN, N. J.

In Industry's Power Plants—

Crystolon Brick

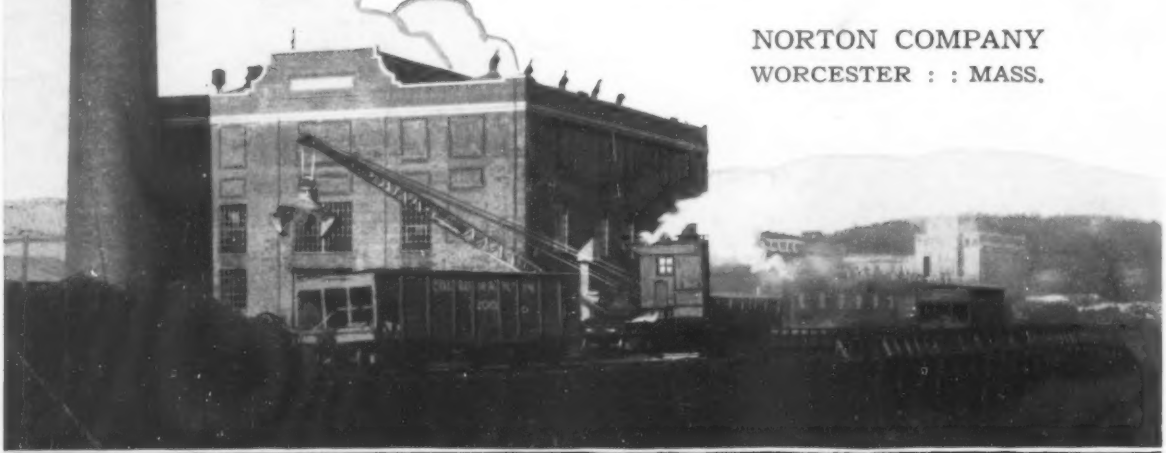
Another Norton Product



In the form of grinding wheels the Norton electric furnace product trademarked "Crystolon" is well-known throughout the metal working industries. And in another field it is gaining distinction, too. Crystolon Brick is reducing refractory costs in industry's power plants.

A heavy duty product for use where boiler operating conditions are exceptionally severe. The extreme hardness of silicon carbide (Crystolon) gives a brick that is strong and dense—that will resist the abrasion caused by mechanical stokers and to which clinkers will not adhere. The exceptionally high refractoriness of Crystolon Brick enables it to withstand the highest temperatures encountered in boiler furnaces.

NORTON COMPANY
WORCESTER : : MASS.



NORTON

Grinding Wheels
Grinding Machines

Refractories-Floor
and Stair Tiles